Fall 2019

IE 655-851: Concurrent Engineering

Paul Ranky

Ver. IE655 Fall 2019

Jump To Course Contents and Schedule

This is your latest, therefore the most current schedule. Last update: August 4, 2019 (Update history: August 4, 2019)

Welcome to the Fall 2019, IE655, The On-line/Distance eLearning / Hybrid Class: Concurrent Engineering & Sustainable Green Systems Engineering Management, to Prepare you to Become a Succesful Innovator & Entrepreneur in this Domain.

Learn About **Concurrent / Simultaneous Engineering**, Creativity, Product & Process Design Innovation Skills, Entrepreneurship, Lean and Sustainable Green Product Design & Development, Incorporating New Product / Process / Service Innovation & Introduction (NPI&I), and Green **PLM** (Product Lifecycle Management) with Digital Design & Digital Manufacturing, Digital Product Design & Development in the new, 'Internet of Things' (IoT) environment, Risk-based Design, and Other Methods, Based on a Set of Analytical, Quantitative and Computational Methods, Tools, DVD Virtual Factory Tours, and Case Studies. The Industrial Internet of things (in this course with a strong integrated systems engineering / design focus) is about integrating smart networked machines, big data and human activities for the purpose of optimization and waste reduction. GE (USA), Rockwell Automation (USA) and CISCO SYSTEMS (USA), just to name a few, predict the IIoT to be an approximately 150 billion USD market within the next 10 years!

In this course we'll also focus on product design quality, design efficiency, effectiveness, empowerment, social networking, advanced visualization methods for problem solving, product and process innovation, analysis of data, and on how to act professionally based on accurate data / information... all with a design / system design focus. Based on many reliable sources, the key words for USA industry for the forseable future are the following:
- Digital Workforce Productivity
- Intelligent Asset Optimization
- Enterprise Operational Intelligence, and
- Scalable Production Management

We are going to focus on these aspects of our rapidly changing world too.

by

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This is an analytical, as well as practical course. Every subject we discuss is supported by real-world industrial and/or R&D challenges and some solutions too. Then we discuss analytical methods, examples and tools too to help you to solve your real-world challenges.

We work in class exactly the same way as progressive thinkers and professionals work in industry... except that we often take it even further. Our imagination is not limited by neither management, nor by budgets... Many of our methods will be truly appreciated by industry in the next 5-10 years, and by then we'll be another 5-10 years ahead of the game... but that is good for you, a student in this class.

We have to be better and be able to continuously improve. The methods taught in this course are relevant not just to innovative product design, manufacture, test and quality control of products, but also to a large variety of service industries, because they reduce system design and development costs, and improve working capital management, by offering powerful sustainable green

engineering methods and software tools.

The engineering processes span the entire product development lifecycle that includes conceptual design, preliminary, design, detailed design, and integration and test. These processes continue to be applied through product manufacturing and support to address defects, technology insertion, and evolving customer needs. The lack of integration in each phase results in inefficiencies, defect insertion, and limits the ability to assess change impacts and respond to changes.

Integrating the development processes is essential from Day 1 on a project. Right from the start, engineers from each discipline must begin working to meet early project milestones such as the procurement of long-lead items. The lack of integration across disciplines can result in early design decisions that can have significant adverse downstream cost and schedule impacts. An organization's engineering change process can be an indicator of the level of integration of their multi-disciplinary engineering processes.

The change process includes identifying the need for the change, assessing the potential impact of the change, implementing the change, and must be managed to ensure proper orchestration among the development team. This often requires program and engineering management to coordinate analysis, design, and test activities that are performed by many engineering disciplines that include systems, software, electrical, mechanical, reliability, safety, test, manufacturing, and others. Each engineer uses their discipline-specific engineering process, tools, and data, and often relies on informal inter-discipline communications and manual exchange of data.

This lack of integration can significantly limit the effectiveness of the overall process. (Ref.: www.engineering.com) (Please note, that in this class you'll learn a lot about this 'integrated approach', mentioned above.)

A few words about...

ASQ (American Society for Quality) Student Chapter at NJIT. ASQ is the largest quality society in the world. Join us, see, hear and network with professionals! We have weekly short meetings at NJIT, as well as almost every month a really nice technical meeting with a presentation and a FREE dinner (usually in a VERY nice restaurant in Newark, or New York City). For the student membership Information PDF: link here. More from your instructor, Dr. Ranky, the founding academic member of the NJIT ASQ Student Chapter. The actual ASQ Chapter Section 300 web site we are part of is here. Please consider joining ASQ. This is a perfect fit for this course as well as for the EM profession as a whole. Remember: Quality must be designed into every product, process and service system. The earlier you learn about quality focused concurrent engineering the better...

Please Read This Syllabus! It contains Vital Information about the course as well as all the Assignments, Homework and Grades! Without reading, understanding and following this syllabus you won't be able to get a good grade in this course.

Academic Integrity: Please refer to NJIT's Academic Integrity web site that contains much information about strategies to promote academic integrity and avoid cheating on class work and exams (http://integrity.njit.edu/). Also, please refer to the Academic Integrity web site that contains much information about strategies to promote academic integrity and avoid cheating on classwork and exams. http://integrity.njit.edu/index.html. The "Best Practices" document developed and is published on the Provost's website (on the policies page) or directly at http://www.njit.edu/academics/provost/docs/Best_Practices_related_to_Academic_Integrity.pdf

During the 2008-2009 academic year, the NJIT Administration worked very closely with the Student Senate to enhance and improve NJIT's Honor Code. The Committee on Academic Affairs and the NJIT Faculty approved the Student Senate's recommendations developed from the findings of the University's Taskforce on the Honor Code. The approved document, "University Code on Academic Integrity" thus replaced the older Honors Code document. (http://www.njit.edu/academics/pdf/academic-integrity-code.pdf)

All students are responsible for upholding the integrity of NJIT by reporting any violation of academic integrity to the Office of the Dean of Students. (http://www.njit.edu/doss/) The identity of the student filing the report remains anonymous. NJIT will continue to adapt its policies and procedures to make clear that academic dishonesty will not be tolerated at this institution.

PLEASE save the **TREES and be sustainably lean and green**! Please DO *NOT* Print this syllabus. Use this web site to read it in this electronic format; it will be updated during the semester. Thank you!

Some novel features of this class, that are going to help you to become a truly 21st century hi-tech professional...

Having worked through this class successfully, every student of mine will be able to:

1. Set up his / her own (virtual) company and web page,
2. Innovate,
3. Collaborate with other companies on a global basis,
4. Design, run and control a simple web site on the open Internet,
5. Learn to read faster than the average,
6. Learn to write executive summaries,
7. Absorb new and relevant information better and faster than the average,
8. Learn new analytical skills and customize tools,
9. Learn multi-variable and multi-dimensional systems thinking,
10. Learn some basic sustainable engineering (i.e. design, manufacturing, quality, and other), lean and green concepts and solutions,
11. Learn to reason and draw conclusions based on facts,
12. Learn to document new knowledge on the web, using their own web sites,
13. Improve his / her communication skills,
14. Learn the benefits of social networking, and
15. Video conferencing, and
16. Others.

Other Related Graduate Courses Taught by This Professor

IE725-407 / EM725-407 (eLearning): Advanced LSS (Lean Six-sigma) Quality Methods: Independent Research Study Class. This is a very novel, progressive course focusing on **Advanced Lean Six-sigma Methods... Customer Requirements Analysis / Quality Function Deployment and Lean Six-sigma Quality**. An excellent course to prepare you for professional certification exams (e.g. ASQ, PMP); to be either simultaneously taken with IE673, or after 673 as a more advanced course with some research experience. This course was designed for modern real-life engineering management entrepreneurs with a quality focus. (Note, that I often discuss some of these subjects during my research seminars I give on invitation to USA, and European MBA Universities.) This elective course runs typically once a year. Sample syllabus on the web (note, that the syllabus is updated every time the course is run): http://www.cimwareukandusa.com/All_IE673/EM725-407Spring2016.html

EM636 (eLearning). This is a novel and very progressive course focusing on modern **Engineering Project Management in a quality framework.** An excellent course for real-life engineering project management entrepreneurs who are looking for zero project failures. (Note, that I often discuss some of these subjects during my research seminars I give on invitation to USA, and European MBA Universities.) An excellent course to prepare you for professional certification exams (e.g. ASQ, PMP); This course runs typically once a year. Sample syllabus on the web (note, that the syllabus is updated every time the course is run): http://www.cimwareukandusa.com/All-ProjManage-EM636Course/EM636Summer2016.html

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A few words on...

A strong focus on creating "T-shaped people" who not only have a "deep technical education," but are also capable of "innovation, creativity, and entrepreneurial sense."

I am pleased to state, that we have been following this approach for the past 20 years at NJIT with my students...

The American Society of Engineering Educators Reports: Stanford's Engineering School Looks To Balance Traditional, Creative Approaches. Inside Higher Ed (May 14, 2010, Epstein) reports, "The undergraduate offerings at Stanford University's School of Engineering could be engaged in a tug of war." The program's current "emphasis on current state-of-the-art technical knowledge must be complemented with an openness to change," according to James D. Plummer, the school's dean. "We need to teach our students to be lifelong learners, to be able to keep updating themselves to be the best they can possibly be throughout their careers," he said. But retaining accreditation is important, "so rather than giving up on the bean-counting basics" Plummer has focused on creating "T-shaped people" who not only have a "deep technical education," but are also capable in terms of "innovation, creativity, [and] entrepreneurial sense." The article details Stanford's program, and some of the differing views on it. Inside Higher Ed notes that, overall, curricula have become "more holistic" since ABET began implementing its Engineering Criteria 2000 standards.

More on what industry is looking for... (ref. Toyota)... Please read this ONLY if you want to become successful in hi-tech USA and in international industry...

The Toyota company-wide culture is the key ingredient in its success. What can we learn of the “human systems” that Toyota put in place?

The Toyota “human systems” consistently support and sustain high levels of performance... and this is exactly what I reward in this

class too... why? ...because I would like you to become successful... These are some of the secrets that I as an educator share with Toyota... and I will try to teach you too in this class (if you allow me...):

1. Find competent, able, and willing employees / students,
2. Start training / educating and socializing your people / students as you hire them / teach them,
3. Establish and communicate key business performance indicators / assignments and grades, that reflect true progress at every level of your organization,
4. Train / educate your people / students to solve problems and continuously improve processes in their daily work / assignments,
5. Develop leaders who live and teach your company's / the class's philosophy, and
6. Reward top performance and offer help / office hrs, etc. to those who are struggling (this is reflected in the grade).

Let me share this with you: The 10 Principles Of Learning (ref.: http://www.peloruslearning.com/the-10-principles-of-learning)
1. Learners need to know where they are going and have a sense of progress towards their objectives.
2. The learning environment has to be one of trust, respect, openness and acceptance of differences.
3. Being aware of and owning the responsibility for learning lies with the learner. Others can only give information and support, and provide feedback.
4. Learners need to participate actively in the learning process.
5. Learning should be related to and use the learner's experience and knowledge.
6. Learning is not only a basic capability but also a group of skills which can be developed and/or learned.
7. Facts, concepts and skills are learned in different ways.
8. Getting ideas wrong can be a valuable aid to developing understanding.
9. For learning to be processed and assimilated, time must be allowed for reflection.
10. Effective learning depends on realistic, objective and constructive feedback

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Due to global competition, as well as because of the environment (specifically global warming), sustainable green design and green manufacturing (Green PLM) is the next huge challenge for all of us! This course will help you to prepare for such challenges! As a result, as an engineering manager you'll lead this crucial change process!

Based on my recent visits to Japan, as Toyota, Denso, Mori-Seiki, Honda, FANUC, Matsushita, Nippon Denso, Panasonic, and other companies I can share with you, that Japanese senior engineers explained the following:

Excellence in product development is the next core dominent competency in engineering because there is more competitive advantage at the early stage of the design than at any other stage... when combined with concurrent product, process and resource engineering we can half our product development time, or even do better than that... this means, that whilst our competitors achieve one product release, we can offer two, maybe three new product releases... this brings in huge revenues that we can further invest in new product development methods, tools and actual products... Concurrent Engineering with PLM (Product Lifecycle Management, Digital Product Design & Digital Manufacturing) is the big weapon now, that is not fully understood by many...

... and the amazing fact, is that most Japanese companies use American invented and created software to create these amazing new product designs... these are CAD methods and tools, CAM, PLM, FEA tools, digital design, digital product creation, digital manufacturing and simulation tools, computer networking tools, robot control software, interactive multimedia interfaces for machine tools and robots, etc.... does it tell you something? (Oh, yes it does, we need to catch up and learn all these great inventions we create here in the USA too!)

Furthermore, consider this:

With the current level and speed of globalization, hundreds of milions of new, able, educated workers are joining the global workforce from China, India, Asia and Eastern Europe. We, as they, have only one choice: innovate better, faster and design and produce at a lower cost, than our competitors... this way all able, hard working and ethical workers in our Mother Earth will have a better life. This is fair competition. Because we engineers. try to improve quality of life everywhere on Mother Earth... and there is one more thing... we all have to do this following lean, sustainable green methods and technologies, else humanity will be wiped out due to toxic waste... Concurrent Engineering is a KEY set of methods and tools to design for the environment...

Advanced, sustainable green design and manufacturing is used in all areas of manufacturing, including product and process design, control, fabrication, test, assembly, disassembly, and remanufacturing / recycling. In terms of green design and manufacturing sustainability we consider an eco-friendly state, or process that can be maintained over time, for a very long time. Also, the ability of an ecosystem to maintain ecological advanced manufacturing processes and functions, biological diversity, and productivity over time. Furthermore, it encompasses the concept of meeting present manufacturing needs without compromising the ability of future generations to meet their needs. In other words, the characteristic of green, sustainable advanced manufacturing is being able to coexist with another

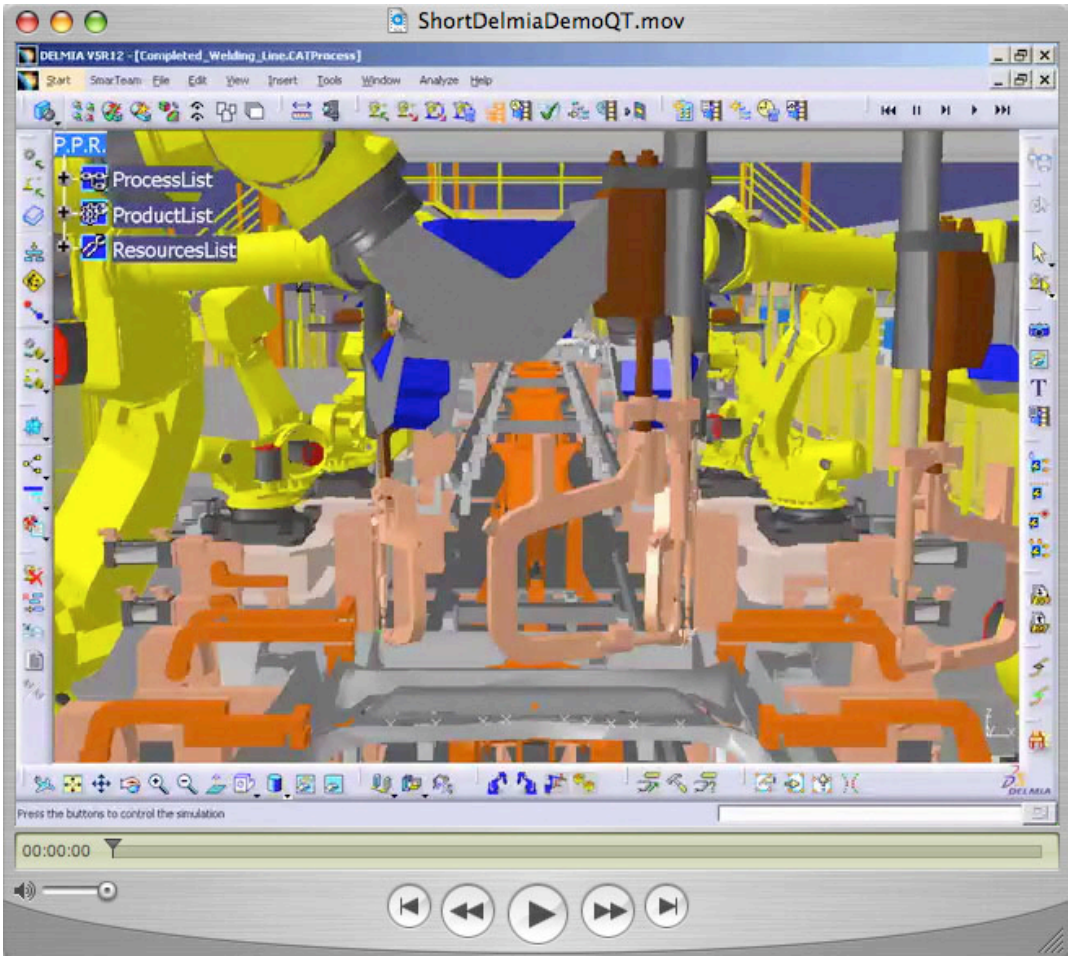
system indefinitely, without either system being damaged. Sustainable green advanced manufacturing concept also emphasizes that the creation of wealth within the community considers the wellbeing of both the human as well as natural environments, and is focused on the more complex processes of development rather than on simple growth or accumulation only.

In terms of green sustainability, please look up the following sites and videos: http://www.cimwareukandusa.com/All-Green/Ranky-GreenEngineering.html In all assignments, please focus on sustainability, and in particular on green sustainability (i.e. toxic waste elimination, non-toxic production processes, green mobility, sustainable business practices, and others). These are very interesting videos, that you should watch to help to learn about this process: https://www.youtube.com/watch?time_continue=1035&v=mMlmjXtnIXIAlso, if you want to read more about this, suggest to look up one of my articles here: Ranky, P.G.: An Integrated Architecture, Methods and Some Tools for Enhancing Sustainable Enterprises and Systems. Article Published in Systems 2015, 3(2), 27-44; doi:10.3390/systems3020027; Abstract and Link to Full Article (FREE access) http://www.mdpi.com/2079-8954/3/2/27

Here is a very short video of a laboratory demo using our IBM donated Dassault Systemes Catia / Delmia PLM (Digital Design and Manufacturing Software via Professor Ranky, at NJIT): I formatted this video in QuickTime.mov, as well as for the Video iPod. You can also click the poster frame below to see it running.

It is truly amazing... Boeing, Toyota, Airbus, Honda, GM, Ford, Nissan, Renault Formula 1, and many others use it. It is the most powerful PLM system in the world. Boeing designs aircraft with it, the Dreamliner 787, and Airbus the A380, and Toyota the Camry.

Please note, that your custom designed eLearning Packs have several of such exciting demos included for your study!



BIG success for PLM! (Ref.: http://news.thomasnet.com/featured/boeing-inks-historic-software-deal?WT.mc_t=PNA&WT.mc_n=alert_0717&channel=newsletter&campaign_type=PNA&campaign_name=0717)

Global aerospace giant Boeing recently signed a $1 billion contract with software provider Dassault Systemes. Boeing's primary goal will be modernizing its production systems to fill its backlog of orders more quickly. The 30-year contract is renewable every

10 years and was awarded after two years of competition. A major component of the contract will be the use of 3D software to improve product and process design. The company's supply chain will also see upgrades stemming from increased visibility amongst subcontractors from a single interface. The contract, the largest ever signed by Dassault Systemes, is seen as a way for the company to grow its presence in the civil aeronautics, defense, and space marketplaces. From Boeing's perspective, they need a quicker transition to digital manufacturing systems. Another significant element of the contract will be bringing Boeing's legacy data from the early 1990s into the modern platform to create a unique reference library.

Some more PLM examples with videos of our related R&D work we have completed for the LSC (The Liberty Science Center in New Jersey). These are the web sites:

http://njit-lsc.njit.edu/pauldesign.html

and

http://njit-lsc.njit.edu/paulrobot.html

In each assignment in this class please focus on **What Problems You Want to Solve and How?** This will make you a more efficient and better professional.

Enjoy!

Why PLM is so incredibly important for advanced design and manufacturing companies, as well as individual design engineers too:

(Edited by Ranky, based on Kevin Prendeville's article. He is a managing director with Accenture's Product Lifecycle Services practice. He can be reached at kevin.p.prendeville@accenture.com.)

Product lifecycle management (PLM) may sound like one of those deep-in-the-weeds business terms, but it has become one of the most important arenas for accelerating product deliveries, reducing costs, and generating more revenues in major manufacturing industries. Going forward, aerospace, consumer electronics, medical device, semiconductors, and wireless infrastructure manufacturers would need to invest even more in product lifecycle management technologies and capabilities and Product Lifecycle Servicesto make this complex process more streamlined, cohesive, and simplified.

So what is product lifecycle management? Put simply, it's all the processes and systems involved in product development from the original product conception through the end of its life. Product lifecycle management involves numerous corporate groups such as marketing, engineering, manufacturing, and purchasing. These processes and systems are particularly designed for use by manufacturers employing thousands of highly skilled designers, scientists and engineers working within global processes across hundreds of current and future products.

Why is PLM so important?

Product development has become strategically crucial to the financial performance of these manufacturing companies so they are investing more in it. They understand and appreciate problems PLM addresses and the benefits it can reap such as lower production costs, as well as accelerations in new product designs and launch schedules and engineering cycle times. (As an example, the new Boeing 787 was designed, manufactured, assembled and tested using PLM methods. More 787 Dreamliner images: image-1, image-2.)

Why is the Industrial Internet of Things (IIoT) so important?

The convergence of machines and intelligent data is known as the Industrial Internet of Things (IIoT). The Industrial Internet Makes Industries Work Better! New ecosystems of connected machines have the potential to increase efficiency, minimize waste, and make people operating them think and act smarter. The Industrial Internet is changing the way we design systems and make them work better, and better, and better...and at a higher level of quality at lower cost... The principles apply to ANY industry, nevertheless the core IIoT ideas were invented by engineers, therefore many of the first implementations are in engineering design, automation, processes, quality management and control, the aerospace, aviation, the airline industry, and others... all other industries will follow soon, since it is a HUGE waste reduction opportunity saving billions of $$$$... anybody NOT interested...?

According to GE (General Electric, USA)... (Ref.: http://www.designnews.com/author.asp?section_id=1386&doc_id=278946&cid=nl.dn14.20151023&dfpPParams=ind_182,industry_machinery,kw_cloud-computing,kw_35,aid_278946&dfpLayout=blog)

• Digital Development Is the Way Forward for Design Innovation

• PLM and Digitalization Will Redefine Engineering and Manufacturing

“GE has 400 global manufacturing facilities,” Carpenter told Design News. “We’ve targeted a subset of those plants to run the Brilliant Manufacturing Software (BMS) suite, so we can look at real-time dashboards in those plants and reach a consistent level of performance and provide tools to optimize output. We’ve also got outside customers using it, and we’re getting a lot of feedback on the best way to deliver these capabilities in the cloud. For the basic production OEE analyzer (performance analyzer module that turns machine data into efficiency metrics), for example, there are about 12 pieces of data that are brought to the cloud, analyzed, and delivered back to the customer in the form of actionable intelligence.”

So far, according to GE, its own facilities and outside customers have been able to significantly improve yield by identifying lost or wasted time, reduce downtime by between 10 and 30%, and identify inefficiencies in every step of the manufacturing process.

What makes analysis of the end-to-end manufacturing process possible, said Carpenter, is the emerging Internet of Things (IOT) infrastructure. “The fact that we can gather this data quickly thanks to networks and sensors, then analyze it and deliver it in the form of intelligence, makes it much more efficient than would have been possible even five years ago,” he said.

Companies need not have state-of-the-art technology and networks to take advantage of the suite, however.

“We’ve categorized equipment into three areas: installed and ready for connection on an existing network, capable of being connected but missing the communications network, and equipment that’s so old it has no connectivity capabilities. In the latter case, we’ve developed ways to hardwire into the equipment and get some of the signals we need -- with a cellular connection, for example -- then bring it all back into the data collector and analyzer so it can yield good results.”

GE plans to take BMS out of the pilot stage and launch it for wide release by the end of this year. Manufacturing customers will be able to choose one or more modules of the suite or the entire platform. The company also has established alliances with PTC to bring the latter's ThingWorx IIoT application into its software portfolio, as well as struck an accord with Cisco to develop best practices for deploying the BMS in the latter's IT environment.

What’s at stake for high-tech manufacturers?

Each year these manufacturers companies spend as much as 25 percent of their revenues—in some cases billions of dollars—on innovation and product development, according to Accenture analysis. But nearly half of the investment is on products that are either late to market or don’t address customer requirements. A one percent reduction in the time it takes to deliver a product to market by improving PLM, for example, can translate to major financial benefits.

While PLM can solve a plethora of problems, a one-size-fits-all offering does not exist. The correct remedies depend on the company, industry, specific needs, and competitive dynamics. Based on Accenture’s extensive experiences with clients, however, the most pervasive and common problems are inefficient end-to-end processes, fragmented data systems, mounting offering and product complexity, and difficulties adhering to more and increasingly stringent regulations.

“We are in a digital industrial revolution,” affirmed Thomas Maurer, senior director of strategy for PLM software at Siemens (ref.: http://www.designnews.com/author.asp?section_id=1386&doc_id=278787&cid=nl.dn14.20151006).

“We see great disruption in manufacturing — size alone is no longer a sustainable advantage [for companies],” said Scott Reese, vice president of cloud platforms at Autodesk. “Three people with funding can disrupt an industry.”

Autodesk and Siemens cited the following as the game-changers:

• Digital mobility from smartphones, tablets, and apps

• Social networking, which generates customer data and collaborative input to develop or fine-tune products

• Preference among OEMs and consumers for custom products

• Analysis of Big Data from smart applications like interconnected machines and systems as well as watches and smartphones

• The cloud, which allows real-time access to projects worldwide and increases the ability of users to work with designs, production processes, and other aspects of manufacturing.

Siemens and Autodesk highlighted different approaches to meeting the challenges of engineering and manufacturing’s digital evolution. Siemens — and much of Europe — refers to the changes as Industry 4.0, aka, the fourth industrial revolution (after water and steam power, electric power, and computing power). Siemens highlighted integrated digital enterprise software suites such as its Teamcenter, in which functions like product design, production planning, engineering and execution, and logistics are optimized

and proven before a dollar of capital investment is spent.

Manufacturing, clearly, is no longer just making and shipping something. Siemens demonstrated this with Digital Twin, software that allows engineers to digitally create, optimize, and prove every aspect of machine and robot use, plant layout, and manufacturing before resources are committed.

Digital Twin, Grindstaff said, is a way of "predicting the future" through realistic simulations that integrate PLM and manufacturing. Siemens uses its Point Cloud Factory Scans to simulate manufacturing and "integrate mechatronics engineering" to "close the loop between ideation and realization" by combining different platforms — electronics, automation, mechanical — in the software.

BMW used the software to improve the design of its assembly plant in Steyr, Austria, and reduce electricity use by 3 million kW per year, for an annual savings of $6.7 million.

One goal of these capabilities is to develop better products faster, which is a challenge. According to findings from Roland Berger Strategy Consultants, cited by Grindstaff, product complexity more than doubled in the past 15 years, while product lifecycles shortened by 25%.

Interestingly, few companies are fully aware of PLM and related software and their benefits. An Autodesk panelist underscored this, observing that suppliers with cloud-based PLM software generate only $75 million in annual sales in a potential $5 billion market.

Improvements to synchronous design intent management, complex sketching, and 3D feature recognition were added to help users "focus on designs, rather than the design tools," with the goal of accelerating the modeling process. Flexible modeling that incorporates synchronous technology is intended to free the user to intuitively produce realistic, accurate designs faster. Synchronous technology combines the speed and flexibility of direct modeling with the precise control of dimension-driven design. Siemens ST8 has also added a Google-like image search function. "We have added 'Like Me' pattern recognition. This lets users take dumb models and make them smart," Dan Staples, VP of Solid Edge development told Design News. "It can recognize holes or recognize patterns of holes. It offers lightning-fast pattern recognition. This enhances productivity by letting users import data and switch out components quickly." (Ref.: http://www.designnews.com/document.asp?doc_id=277646).

Developments predicted by Autodesk and Siemens in software, among them easier use and closer integration with machines, could significantly increase market penetration.

There is a brave new world of design engineering and manufacturing at hand that is challenging and disruptive to conventional models but filled with opportunity that has yet to be realized.

"Everybody needs to deliver a product that can be easily manufactured", and in this class (IE655) you will learn a lot about that! Design engineers, especially new engineering graduates, are always ready to come up with innovative and cool new products and ingenious systems. Yet, design for manufacturability (DFM) comes to dominate their creative process; their designs need to meet very specific terms for manufacturing. This can include everything from working with approved parts, to where a hole can and cannot be placed, to what types of materials can be used, to who needs to sign off on the design before it moves forward (more here in ref.: http://www.designnews.com/author.asp?section_id=1386&doc_id=278936&cid=nl.dn14.20151019&dfpPParams=ind_186,kw_2,aid_278936&dfpLayout=blog).
The responsibility for ease of manufacturing has moved higher on the list of design engineering responsibilities. "Design for manufacturing is a growing concern because the supply chain has become more complex with suppliers and contract manufacturing," Scott Reedy, director of product marketing for Arena Solutions, told Design News. "Everybody needs to deliver a product that can be easily manufactured."

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The Four+1 Key Product Development Problems/Challenges...

Inefficient end-to-end processes: Because of deeply ingrained silos within these companies, the marketing, product planning, engineering, manufacturing, purchasing, sales, and service groups often operate independently. Too often these groups are disconnected islands that rarely talk to each other. To boost efficiency, they need to operate in a more coordinated and streamlined fashion by determining areas where the overall process can be improved. To further improve end-to-end process efficiency, they should enhance and supplement their work forces, as well as enhance product design, validation, and manufacturing.

Fragmented data systems: When investing in product development, companies seek data about requirements, designs, parts, bills of material, software codes, and quality. But within these companies such data often remains disorganized, unclear, redundant and dispersed throughout different groups spread among hundreds of applications. Valuable product development data does not get captured, categorized, managed nor disseminated efficiently. These firms need to create centralized data owners and management systems. By doing so, they increase accessibility of accurate, timely and reusable data throughout the business. This

increases process efficiency and re-use of product development data and, therefore, investment dollars.

Mounting product complexity: Most companies have seen a steady increase in their number of product offerings, which often combine sophisticated services and features. But due to the mix of mechanical, electronic, software, and service elements, these products are increasingly complex. As such, the offerings are more complicated to conceptualize, develop, and deliver to market. These companies need to examine and enhance the profitability of different product types and features as well as project platforms. Furthermore, if companies are challenged to gather excellent internal and external product ideas, they can accelerate innovation processes, incubate new businesses, and create and mine new product ideas.

Difficulties adhering to increasingly stringent regulations: In the product development arena of high-tech companies, the number of global regulations continues to grow and often has become more complex. To avoid fines and penalties, these companies need to be vigilant and well-organized in following product regulations. They need to more uniformity in the ways in which these regulations are abided by and tracked. (Please note, that the automotive, aerospace, computing industries show many good examples here, and the building and construction industries show many poor examples...)

Lack of Design for Manufacturing, Design for Quality, Design for Assembly / Disassembly, Remanufacturing, Recycling, Sustainable Green Engineering Knowledge: Unfortunately, traditional engineering schools rarely educate their design engineers to understand manufacturing, quality, assembly, disassembly, maintenance, remanufacturing, and sustainable green engineeringprinciples. With globalization, when the distance between design and manufacturing / assembly activities is huge, this is even more important than ever before...

Please note, that in this course we focus on many of the above issues to make sure, that future engineers understand this complex system interaction and integration, and therefore become better designers and engineering managers.

Final Thoughts...

It’s not an overstatement to say that PLM is fast becoming one of the most important areas in manufacturing companies for improving business performance. The potential improvements PLM offers are widespread and significant. They can be realized using a number of approaches and techniques. This is the time for manufacturers to derive all the benefits they can out of their PLM processes. (Edited by Ranky, based on Kevin Prendeville's article. He is a managing director with Accenture’s Product Lifecycle Services practice. He can be reached at kevin.p.prendeville@accenture.com.)

Why is PLM, Sustainable Green-PLM not taught widely in most universities, colleges?

There are many reasons for this, but most importantly due to the complexity of the subject.

Ideally, you should enter the world of **sustainable green-PLM** as a design engineer, or as a high-tech, advanced manufacturing systems engineer with significant analytical, as well as practical knowledge and experience.

In other words to start with, you should be either a good design engineer as well as a good manufacturing systems engineer with green-sustainability in mind, or a good manufacturing, as well as design engineer, to really appreciate this subject... the same applies for the professor who teaches you, guides you in your studies... unfortunately there are only a few of these cases... BUT, not to worry, in this class I'll give you a step-by-step introduction to the key concepts, methods and even to some of the tools.

ALSO, you'll see MANY case studies in the eBook, as well as in the videos we work through in this course. On the top of this, the assignments are ALL designed by you, supervised by myself, for the purpose of you mastering this subject... I hope you agree, that it cannot get better than that!

Valuable Insight from Jonathan Ive (Apple)...

Jonathan Ive, Apple's Senior VP of Design, made a rare public appearance at the Design Museum in London (via Cult of Mac). At the event, he discussed everything from his view on the future of design to his opinions on failure with museum director Deyan Sudjic.

“We shouldn’t be afraid to fail - if we are not failing we are not pushing. 80% of the stuff in the studio is not going to work. If something is not good enough, stop doing it.”

The talk with Sudjic also included a roomful of up-and-coming design students, with Ive offering additional perspective on the design process and rejection.

"The best ideas start as conversations. A small change at the beginning of the design process defines an entirely different product at the end. At the start of the process the idea is just a thought - very fragile and exclusive. When the first physical manifestation is created everything changes. It is no longer exclusive, now it involves a lot of people." Ive also mentioned, "There are 9 rejected

ideas for every idea that works."

Unfortunately for those design hopefuls listening to Ive, the odds of working in his team are slim. Apple's Industrial Design team is notoriously difficult to get into, in large part because its members never leave the company. The eighteen-person team hasn't seen a single member leave for fifteen years.

"I like to work in a small team," Ive told Sudjic. *"There is only 18 of us on the design team. Nobody has ever left."*

Ive also touched on how to gain experience in the field, design studies in schools today, and the difference between making something different and making it better.

Our goal is to desperately make the best products we can. We're not naive. We trust that if we're successful and we make good products, that people will like them. And we trust that if people like them, they'll buy them. And we figured out the operation and we're effective. We know what we're doing, so we'll make money, but it's a tough sequence.

Ive has famously remained out of the spotlight for much of his tenure at Apple, but has opened up considerably since taking on new responsibilities for software design and more recently with the impending launch of the Apple Watch.

Why U.S. Manufacturing Is Outpacing China...
Reference: http://www.totallyintegratedautomation.com/2016/05/u-s-manufacturing-outpacing-china/

The increased competitiveness of U.S. manufacturing has been talked about for some time; but now a number of studies are adding the weight of research to the conversation. The U.S. is poised to regain its number one manufacturing status as it embraces digitization, automation, and electrification in reinventing the sector.

Much has been made in recent years of the renaissance of American manufacturing, particularly in the wake of China's emergence as the global leader in manufacturing competitiveness. But the times, as an iconic American singer once noted, they are a changin'. The United States is poised to regain its number one status.

According to a new survey of global CEOs and other senior executives—the 2016 Global Manufacturing Competitiveness Index developed by Deloitte and the Council on Competitiveness—the advanced manufacturing technologies at the core of Industry 4.0 are driving the U.S. back to being the most competitive manufacturing nation in the world. According to the study, the U.S. is currently ranked second behind China, but is expected to regain the top position by the start of the next decade. A recent article in Industry Week observes the drivers of this development: "U.S. manufacturers are investing in technologies such as predictive analytics, the Internet of Things (IoT), smart factories, and advanced materials that will be keys to improved competitiveness in the coming years."

A study by the German research group Roland Berger on digital manufacturing in the automotive sector underscores the import of the Deloitte survey. According to Roland Berger, the U.S. "ticks all the right boxes" for locating digital factories to compete and win on a global scale. Among the advantages they see the U.S. as holding:

Digital factory ecosystem. The United States is home to eight of the top 10 information technology companies, including such vaunted names as Intel, Microsoft, and Google. The U.S. has a handful of tech clusters, including San Francisco, Seattle, and Boston. These clusters are crucial to the formation of talent pools necessary for all firms in the digital factory ecosystem and are supported by world-class educational facilities such as Stanford, the Massachusetts Institute of Technology, and Carnegie Mellon.

Modern infrastructure and proximity. Digital factories enhance the value of manufacturing clusters. The U.S. possesses a unique combination of automotive clusters, reliable transportation infrastructure, and Internet integration.

Educated labor force. Digital factories will need a large number of employees with degrees in science, technology, engineering, and mathematics (STEM) and the U.S. has one of the best workforces for meeting these demands. The U.S. has [more than] 3,200 colleges and universities that offer degrees in the STEM fields that turn out [more than] 570,000 graduates each year. For an automotive OEM or supplier looking to implement a digital factory, the U.S. has the right talent base to meet the demand—especially compared to emerging markets.

Government support. The U.S. is an attractive place to invest in digital factories due to the amount of federal and local incentives being offered to invest in these technologies and create the manufacturing foundation of the future.

Examples of automotive companies taking the digital factory path in the U.S. include Maserati and Faraday Future (Faraday). Maserati teamed up with Siemens in launching the Maserati Ghibli in 2013 using a suite of simulation and tracking tools to streamline production and design. The complex production processes were planned, monitored, and optimized using software.

Maserati also employed software for flexible automation of the production line and even simulated the production process before committing to a production line configuration. Finally, Maserati elected to digitize the design using NX software to improve communications across functions and increase the pace of innovation.

Faraday, which unveiled a stunning electric vehicle concept at this year's Consumer Electronics Show, is investing $1 billion in a 3-million-square-foot, state-of-the-art digital manufacturing facility on approximately 900 acres in North Las Vegas. The project is expected to create 4,500 direct jobs on site. While the company is not expected to move to production until 2018, its to-market arc appears to be even faster than that of Tesla.

How to Move Forward

"Taking the path to the digital factory is a choice manufacturers will have to make or be left in the wake of competition," says Raj Batra, president of Siemens Digital Factory. "The competition is not just within domestic economies, but rather is global; companies must look at the global level, and the global development of digital manufacturing, to stay competitive."

The Deloitte study underscores this perspective by pointing to the increasing importance of the so-called "Mighty Five": Malaysia, India, Thailand, Indonesia, and Vietnam. "These nations could represent a 'New China' in terms of low-cost labor, agile manufacturing capabilities, favorable demographic profiles, market, and economic growth."

At the recent Manufacturing in America symposium, futurist Jim Carroll advised manufacturers to "think big, start small, and scale fast" in order to begin the journey down the path to digital factories. The Roland Berger report lists a number of specific use cases that companies should prioritize right now as they incorporate Industry 4.0 technologies.

These should be top of mind as initiatives move forward:

- Demand-driven provision of material and tools
- Additive manufacturing/rapid prototyping/3D printing
- Self-optimizing systems
- Unitary, RFID-based parts tracking and IIoT (Industrial Internet of Things)
- Smart storage
- Predictive maintenance
- Smart handbooks and process documentation (a.k.a. interactive multimedia user and system manualas)
- Cobotics (a.k.a. collaborative robotics)
- User-friendly operations dashboards (a.k.a. Visual Factory Management)

"It's not just about buying software," says Batra. "The steps are rather clear: Assess your capabilities, identify your goals, and then make and implement a plan of how to get where you need to. When it comes to doing this, Siemens can help. We've proven it around the world."

How This Course Helps You To Learn To Innovate… and Why Innovation is Important…

The world is changing rapidly… and those of us who don't want to accept change and cannot innovate for the better, will end up as followers… and will not be in leadership positions in engineering management, project management, engineering product, process or service system design… including managing hardware, software, as well as workforce developments… (all tightly integrated and related fields of course…).

This course helps you to learn how to innovate. It helps you to understand and learn how to drive some aspects of crucially important innovation, and the positive change processes. (Note, that this is not a commercial. Every statement below is supported by facts. It is trying to clarify the future a bit… for You.)

What is innovation? Innovation is the action or process of innovating.
Synonyms include the following: new thing, new method, change, alteration, revolution, upheaval, transformation, metamorphosis, breakthrough, a new method, a new idea, a new product, process, service, a new system, etc. (Example: 'technological innovations designed to improve energy efficiency'.)

Innovation is the process of translating an idea or invention into a product, process or service that creates value. To be called an innovation, an idea must be replicable at an economical cost and must satisfy a specific need. Innovation involves deliberate application of information, imagination and initiative in deriving greater or different values from resources, and includes all

processes by which new ideas are generated and converted into useful products.

In business, innovation often results when ideas are applied by the company in order to further satisfy the needs and expectations of the customers.

In a social context, innovation helps create new methods for alliance creation, joint venturing, flexible work hours, and creation of buyers' purchasing power.

In product / process / service systems, innovations are divided into two major categories:

1. Evolutionary innovations, that are brought about by many incremental advances in design, system integration, technology or processes (e.g. when an improved, faster and more reliable computer is announced), and

2. Revolutionary innovations, which are often disruptive (e.g. when digital HD video replaced analogue video, or when paper-based files were replaced by computerized databases, or when traditional analog phones were replaced by smartphones).

Innovation is synonymous with risk-taking and organizations that create revolutionary products or technologies take on the greatest risk because they create new markets. (Ref.: http://www.businessdictionary.com/definition/innovation.html)

Obviously innovation is critically important for every person, company, university, country and our world as a whole. As an example, just think of how global warming affects all of us, and all the innovative methods, tools and technologies that we are deploying worldwide to reduce the effects of global warming.

What the Future Looks Like… and How Should We Prepare to Lead? After this introduction about innovation, let me summarize what is happening in our fast pacing innovation world, and the major trends around the world in the coming years and decades.

We are networked and connected 24/7 as a result of modern Internet technology. We have invented ways to connect, and work together, figure out customer requirements, product / process risks, processes, customer and process behaviors and others, that were unthinkable even just 10-15 years ago.

We can collect data from online storage in the cloud, from social networks, from Facebook to LinkedIn, and Twitter. We have moved on from expensive long-distance and international phone calls to free Internet-based solutions, like Skype, email, Whatsapp, and many others.

We have moved on from single workstations to collaborative design, manufacturing and the Industrial Internet of Things (IIoT)… and this is now part of everything we do, all the time, 24/7. We work with each other in increasingly more collaborative and distributed ways… and this trend will go on for a long time because diversity in knowledge and teamwork means 2+2 = 5…

It is also true for how we communicate with customers in general. The voice of the customer (VOC) is more empowered than ever before in every product, process / service system design we can experience / analyze. Yes, customers are more in charge of everything we develop therefore we have to listen carefully, then analyze the results, and then innovate, design and produce accordingly.

How can we capture the customer's voice? There are several solutions… here is one: the interactive multimedia eBook in this course has a substantial chapter, an analytical method as well as several active code tools / spreadsheets on how to capture, feed and integrate customer requirements into the quality design process. We call it CORA, Component Oriented Customer Requirements Analysis with DOE, Ranky-Taguchi Design of Experiments. This is because we break down the customer requirements into components, and objects, following an object-oriented approach. Figuring out what customers want most and how we could achieve customers' desires, needs and wants must be everybody's interest since one way or the other we are all designing systems for customers; else we cannot stay in business…The fact is, that this method works very well in industry. All major US and international companies use this, or similar method, to capture and analyze customer needs, wants and desires.

Customers today share opinions on-line in a matter of seconds, about all products all the time, around the world. As a result of this radical connectedness, hierarchies of communication have flattened the world, reshaped the power relationship between rulers and masses, and even between management, engineers and associates (yes, the world is flat in this sense, and also smaller, due to the networked interconnectedness).

These are huge customer-driven forces, that make this change happen (they basically drive demand and innovation to new levels).

Also, complexity is increasing. Today's world is more complex and more integrated too.

Building products used to be simpler; although innovation was always hard. There were major limitations in the past; and still there are, nevertheless significantly less… just think of this: hardware products could only handle so many lines of code; web applications only had to worry about a couple of browsers and screen sizes, and there were fewer programing frameworks too.

Today, hardware contains a lot more software. This is the way we can innovate faster, customize systems, and make systems smarter too!

Software products need to consider many more devices, customer behaviors and conditions, culture and others, and open source has provided the development community with many more libraries, frameworks and languages from which to choose.

Object-orientation and reusable code, and objects in the physical domain (a.k.a. modules, in modular designs, invented by Egyptians and other engineers who built pyramids 3800 BC and even earlier!), are extremely important here too. All of this leads to innovation. A greater number of platforms and browsers must be supported. This has introduced a huge amount of complexity, as well as forced many software engineers to innovate.

In the mobile world: smartphones are now the norm, with more sold worldwide than traditional feature / desktop phones. We're also adding tablets and wearables (e.g. the Apple Watch) to the array of connected devices. We are connected everywhere in the world with most of our devices (e.g. laptops, desktops, tablets and phones) simultaneously, and we are using these technologies when we work, travel, work out, study, help others in need, eat and dine, fish and ski… all the time and everywhere; we live with these connected devices 24/7!

They help us to find where we are (using maps with GPS), how fast we are traveling on our bikes, what is the weather like anywhere in the world, write music on the top of a mountain, converting temperatures, currencies and distances, and millions of other apps focusing on problem solving in our interconnected world.

Mobile devices are now part of every product, process, and service system design…

Just think of one question: Can you imagine a product today without a website, and an electronic user manual that can be accessed anywhere, anytime, by literally anyone? And customer service over the Internet, from anywhere in the world for free (including free Skype-ing, chatting, emails, etc.)? Of course not. And all of this 24/7 around the world.

So, if you have to change a faulty part on your sailing boat in Palau you can get it fixed with proper multimedia customer support over the web within minutes, versus weeks or months! Or if as a designer need feedback about your automotive part design quality you can data mine the service records of a very large number of cars due to the IIOT (Industrial Internet of Things) capabilities of your systems.

This is why in this course we have collaborative companies in the eLearning Pack, and also a comprehensive interactive multimedia eBook with text, videos, 360 degree interactive panoramas, active code / spreadsheet tools to compute with your own data, rather than traditional paper-based textbook, or even a typical PDF eTextbook with text and some images… and this is why in this course you are also asked to conduct social networking exercises based on the up-to-date articles I am sending you; all of this relates and helps you to innovate, collaborate and become a leader in this complex and rapidly changing world. And all of the above helps you to learn about, and experience the beauty and the power of innovation. This is the real value of the eLearning Pack.

So, how do I help you in this course to achieve the above goals ? You create and populate your own (virtual) company's website, you invent a product, process or service, you collaborate with the eLearning Pack companies, you conduct your processes, customer requirements analysis, process risk analysis, statistical work, social networking, human error detection / prevention, and others. All of this helps you to learn and experience the magic of innovation! Innovation, that will be rewarded with a dream job!

In the social networking world the modern hardware devices we've started using since early 2000 help us connect to each other through a number of highly adopted global social networks. (Note, some prefer their own, more secure social networking solutions…) It's easier than ever to share information and opinions across the world instantly. This has major social, political as well as economic impacts. The world's political systems, as an example, have reacted to such system design changes by either enabling, or suppressing such open changes in fear of losing their positions of control… but change is inevitable at all fronts.

As an example, consider this: traditional printed books are being replaced in most universities in the world by interactive multimedia talking books with active code to calculate with… because they are better; they help to learn faster, more involved, more customized (e.g. you can calculate with your own data), in a collaborative fashion with others, and with more fun too because they help the students to explore and innovate; learning is hard work, it must be more fun… everybody knows this.

New generations, in particular the millennial generation wants change and wants to create new designs and systems that fit their need… change is inevitable even in suppressed societies… in open, progressive societies change is welcome and celebrated because it helps to make life (in most cases) better quality!

In the corporate world of enterprises, as an example, Google is one of the global leaders and is shifting from just software towards more complex product systems, such as self-driving cars, Google Glass, robotics and smart home systems. Amazon has released Kindles, Fire-streaming entertainment devices and mobile phones. Apple has become the most valuable company in the world and

many companies see Apple as the source of innovation light… this is mainly because Apple always focused on customer-centered innovation, hardware, and software, in integration. Many companies copy whatever Apple develops as fast as they can, or cannot… In response, in most cases, Apple responds by innovating faster and better… and integrating their systems better and better… and setting better and better sustainable green engineering standards too. This is good change and positive customer focused innovation.

We can now communicate across teams in many ways that were unavailable 10-15 years ago, enabling modern, distributed teams to work together more efficiently. However, the growth in distributed teams also amplifies the organizational, as well as IP (Intellectual Property) theft challenges of product development and delivery. It also raises the bar on cybersecurity.

It should be noted, that if done right, the data collected from failure can be valuable and actionable feedback. Product, process and service system development management is not only about defining what needs to be built but also about designing customer and stakeholder expectations. By defining outcomes and managing expectations with the rest of the organization, you'll be better able to utilize the data obtained from product failures.

In my courses in the multimedia eBooks we have a great quality method and tool, called PFRA, Process Failure Risk Analysis. This is an extended version of an ISO, International Standards Organization method and tool, called FMEA, Failure Mode Effects Analysis. It helps to identify risky processes and keep them under control. This reduces, and often avoids failure entirely! It is also an excellent source for risk-focused product, process system innovation. (Interesting fact: in 2015, ISO, the International Standards Organization has changed the focus of the well known ISO 9001:2015 quality standard and is now emphasizing risk management. I have introduced at least some level risk management in virtually all eBooks and all courses I have taught since 1995… and that is 20 years earlier than ISO 9001:2015…)

Success is theoretically about getting it right. Agile and the idea of working product development, including working software development, is about putting it out there for feedback, which means you are not always going to be right.

What's key here is to test and validate your designs first, so that you make it as best as possible, and then be prepared to react to the feedback so you can act quickly and continually. This builds loyalty and admiration in a world where customers are highly engaged and demand interaction. (Apple products are good examples. They are far from perfect, nevertheless Apple listens to customers' feedback and tries to continuously improve…)

In practical terms, the above means the following:

• Data (big data!) and science, statistical evidence will drive decisions in the future, and therefore your decisions should be improving too (to achieve this, in this course our method and tools include process modeling, and statistical analysis, control charts for variables and attributes, and other lean six-sigma quality tools, amongst others)

• Human culture and the way different cultures react to product innovation will be the new focus, and therefore your customers will increasingly enjoy your products (to achieve this, in this course our method and tools include process modeling, social networking, video-based education to explore different cultures, collaborative company analysis, amongst others)

• Individual behavior will be a driver and your customization procedures will consider individual customer behavior (to achieve this, in this course our method and tools include CORA, process modeling, and stat. analysis, amongst others)

• Tools will play a larger role; just look at the millions of apps available now, following object-oriented development principles and very easy to use user interfaces. (In our course the eBook is built of web-browser compatible objects and the tools are typically either web-based or MS-Excel-based, that are easy to use. Also, the videos in the eLearning Pack, and also in the eBook(s) help you to understand why and how to use these tools. This is very important. It is not enough to be able to use the tools, but also to use them well for the purpose they have been designed for…)

• Finding ways to constantly provide visibility to the organization will be ever so important. (This is why knowledge management over the web, using your own web pages are very helpful here.)

• Allowing communication and opinions to flow freely will be crucial to enable innovation. (Note: in companies and societies in which dissenting opinions are suppressed, innovation suffers greatly!)

• Constantly asking if people understand not only what they are doing but also why. (Interaction, communication in live as well as in my eLearning classes is established by emails, video-conferencing over the web, discussing each others' web pages, as well as discussing the up-to-date, topic-related social media discussion articles I post for every student in the class. In the live class we have several small group exercises and team presentations during the semester.)

• Opening dialogue about culture. (My classes are technical, nevertheless we spend time on cultural aspects by reviewing several full length videos, shot in various parts of the world in the eLearning Pack. We also refer to cultural aspects when we discuss quality design, requirements, expectations, audit, out-of-control situations in quality, and others. We use many tools and templates

for this.)

• Embracing a quality process focus at every level. (We have many tools for this and our process modeling methods, tools and templates are ISO compatible. We also use many lean six-sigma quality tools, amongst others.)

• Starting with too much information of a dream system, then working your way back to find the balance and a realistic system design

• Creative, imaginative, innovative new products. (Every student who completes the assignments in my classes end up with a creative, imaginative, innovative new product, process, or service, that he or she has created as part of the coursework. This is documented in the open Internet, in a web site, created and maintained by the student, allowing him / her to promote his / her work to a potential employer. This really works well!)

• Machine intelligent, smart devices and add-ons will effect our future greatly. While we do not create such devices physically in the class, individual student-designed projects often have such elements in their project work. (Note, that there are over 25,000 student created assignments on the web, that my students have created in the past.)

• Brand loyalty because products change all the time. We are not commercial in this class, nevertheless students take pride in their web sites and promote their own brands. By doing so they understand the importance of brand loyalty.

• Intellectual property is the most valuable attribute, commodity in our time. This is because innovating is hard, stealing and illegally copying is often easier… Some researchers and engineers, artists spend years on innovating, creating a working prototype, a piece of art… IP, and IP protection is therefore one of the most important and challenging aspects of our interconnected world.

• Renewable energy prices are dropping very rapidly due to efficiency increases. Alternative energy sources are becoming viable (e.g. solar is now 42% efficient, vs. 8-10% as it was in 2000!) In all of my courses and eBooks there is a sustainable green engineering focus. All students understand the importance of this.

To summarize, the world looks very different today than it did in 2000, nevertheless the above principles will last for many years because they promote waste reduction, sustainable green engineering and systems, quality, innovation and progress with a positive, quality focus. Just consider this for the future: if we could resolve food, energy, health and education for the rest of the world, over a billion new minds could contribute to innovation! … and this is not an impossible task at all. We could do it! Let's do it and change the world one-by-one… together.

About positive psychology principles, implemented as 'flow'...

Please note, that in this class we follow positive psychology principles, implemented as 'flow' (please see below). Positive psychology is the scientific study of the strengths that enable individuals and communities to thrive. The field is founded on the belief that people want to lead meaningful and fulfilling lives, to cultivate what is best within themselves, and to enhance their experiences of love, work, and play. (Ref.: https://en.wikipedia.org/wiki/Positive_psychology).

Positive psychology is "the scientific study of what makes life most worth living", or "the scientific study of positive human functioning and flourishing on multiple levels that include the biological, personal, relational, institutional, cultural, and global dimensions of life". Positive psychology is concerned with eudaimonia, "the good life", reflection about what holds the greatest value in life – the factors that contribute the most to a well-lived and fulfilling life.

Positive psychology began as a new domain of psychology in 1998 when Martin Seligman chose it as the theme for his term as president of the American Psychological Association. Mihaly Csikszentmihalyi (born in Hungary in 1934, Europe, emigrated to the USA at the age of 22) and Christopher Peterson are regarded as co-initiators of this development.

Csikszentmihalyi is noted for his work in the study of happiness and creativity, but is best known as the architect of the notion of flow and for his years of research and writing on the topic. He is the author of many books and over 120 articles or book chapters. Martin Seligman, former president of the American Psychological Association, described Csikszentmihalyi as the world's leading researcher on positive psychology. Csikszentmihalyi once said: "Repression is not the way to virtue. When people restrain themselves out of fear, their lives are by necessity diminished. Only through freely chosen discipline can life be enjoyed and still kept within the bounds of reason." His works are influential and are widely cited. (Ref.: https://en.wikipedia.org/wiki/Mihaly_Csikszentmihalyi).

In Csikszentmihalyi's seminal work, Flow: The Psychology of Optimal Experience, he outlines his theory that people are happiest when they are in a state of flow — a state of concentration or complete absorption with the activity at hand and the situation. It is a state in which people are so involved in an activity that nothing else seems to matter.

The idea of flow is identical to the feeling of being in the zone or in the groove. The flow state is an optimal state of intrinsic motivation, where the person is fully immersed in what they are doing. This is a feeling everyone has at times, characterized by a feeling of great absorption, engagement, fulfillment, and skill—and during which temporal concerns (time, food, ego-self, etc.) are typically ignored.

In an interview with Wired magazine, Csíkszentmihályi described flow as "being completely involved in an activity for its own sake. The ego falls away. Time flies. Every action, movement, and thought follows inevitably from the previous one, like playing jazz. Your whole being is involved, and you're using your skills to the utmost."

Csikszentmihalyi characterized nine component states of achieving flow including "challenge-skill balance, merging of action and awareness, clarity of goals, immediate and unambiguous feedback, concentration on the task at hand, paradox of control, transformation of time, loss of self-consciousness, and autotelic experience".

To achieve a flow state, a balance must be struck between the challenge of the task and the skill of the performer. If the task is too easy or too difficult, flow cannot occur. Both skill level and challenge level must be matched and high; if skill and challenge are low and matched, then apathy results. (Ref.: https://en.wikipedia.org/wiki/Mihaly_Csikszentmihalyi).

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Ranky, P.G.: Key R&D and eTransition Trends in US and International Collaborative Design & Manufacturing Enterprises: An interactive multimedia eBook publication with 3D objects, text and videos in a browser readable format on CD-ROM/ intranet by http://www.cimwareukandusa.com, CIMware USA, Inc. and CIMware Ltd., UK, ISBN 1-872631-65-7, 2003-2015. Multimedia design

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Nadler .S. F., Ranky, P.G and Ranky, M., 2002-2003: A 3D Multimedia Approach to the Diagnosis of Low Back Pain (Vol. 1 18 & 40 year old males), An Interactive 3D Multimedia Presentation on CD-ROM with off-line Internet support (650 Mbytes, approx. 150 interactive screens, 50 minutes of digital videos, 3D internal and external body tour, animation and 3DVR objects), by CIMware (IEE and IMechE Approved Professional Developer), ISBN 1-872-631-63-0, 2002-2006, Multimedia design & Programming by P G Ranky and M F Ranky.

Roman, H.T. and Ranky, P.G.: A Case-based Introduction to Service Robotics; An interactive multimedia eBook publication with 3D objects, text and videos in a browser readable format on CD-ROM/ intranet by http://www.cimwareukandusa.com, CIMware USA, Inc. and CIMware Ltd., UK, ISBN 1-872631-48-7, 2003-2015. Multimedia design & programming by P G Ranky and M F Ranky.

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Ranky, P G: Novel Automated Inspection Methods, Tools and Technologies: Assembly Automation, An International Journal, Vol. 23, No. 3, Emerald Publishing Ltd., England, pp. 252-257.
Ranky, P G: Advanced Machine Vision Systems and Application Examples: Sensor Review, An International Journal, Vol. 23, No. 3, 2003, Emerald Publishing Ltd., England, pp. 242-245.

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Ranky, P.G.: Customer Needs, Wants & Requirements Analysis: Automotive Exterior Rearview Mirror; An interactive multimedia eBook publication with 3D objects, text and videos in a browser readable format on CD-ROM/ intranet by http://www.cimwareukandusa.com, CIMware USA, Inc. and CIMware Ltd., UK, ISBN 1-872631-67-3, 2003-2015. Multimedia design & programming by P G Ranky and M F Ranky.

Ranky, P.G.: An Integrated Architecture, Methods and Some Tools for Enhancing Sustainable Enterprises and Systems Article Published in Systems 2015, 3(2), 27-44; doi:10.3390/systems3020027; Received: 9 February 2015 / Revised: 14 April 2015 / Accepted: 24 April 2015 / Published: 4 May 2015; Show/Hide Abstract and Link to Full Article (FREE access) http://www.mdpi.com/2079-8954/3/2/27

http://www.businessdictionary.com/definition/innovation

Now a bit about of my motto: *'Happy Learning for REAL!'*

This is what my recent graduate students wrote about this course:

Professor Ranky,

Thank you for your teaching this class it was a great experience for me and everything that I have learned I am going to utilize in my professional life. I hope that you can be my professor again, thank you again for everything
Rahadames

Thank you for a rewarding semester.

Ryan

Professor,
Semester is done and I will miss this gorgeous class.

Happy Learning for REAL !

Sincerely
Ahmed

A - YAY!!!!
:)
You just made my day!

Thank you,
Irene

Dr. Ranky,

It has been a pleasure working with you, again! The facts that I have picked up throughout the classes you have offered me has enlightened my interest and knowledge in the field. Thank you for making all this information and knowledge easily accessible.

Yehya

It was a pleasure taking the study course with you.
Atif

Respected Sir,
I really want to sincerely thank you and appreciate for providing me an opportunity to learn Concurrent Engineering and its aspects. I had already worked taken Total Quality Management in class before and did great, and both these subjects have proved to be immensely beneficial, especially to better understand the engineering aspects based on my experience working in the Oil and Gas Industry. It has also helped me to better understand the management and engineering aspect of different sectors.

This subjects have been challenging though a great tool for deeper understanding of project management skills required in the industry. I really appreciate your efforts, time and co-operation to help me in every way by your kind suggestions and valuable inputs for the assignments. It's been really delightful to take this course for the semester.
Thanks and regards,
Niketu

Also, thank you for the teaching moments it was a pleasure working with you for the past two semesters.

Have a good Holiday!
Mon

In addition to the evaluation form I would like to thank you also for the amount of knowledge you have helped me gain through these courses.

I have been also working at Sanofi Aventis pharma on a Unit Dose Conversion Project.The principles of CORA, PFRA, CIMpgr modeling, etc have been of immense help to me for the projects I have been part of here.The best part is that these tools can be applied in real life projects.

I am finally graduating this semester and I am delighted that these methodologies I learned in the TQM and CE courses have real applications, rather than being mere theoretical concepts.

Thank you for all the help Professor.

Wish you a merry christmas and happy new year!!

Thanks !!
Best Regards,
Anup

Professor Ranky,
My only regret is that I wasn't able to take this course in person. I imagine your real world experiences would have been quite interesting... you seem to enjoy living as much as you enjoy teaching.

Anyway, thoroughly enjoyed the working tools you provided... I will have definite use for them.

Cheers,

Steve

I have learned a lot form your courses, and would suggest it to my friends.

sincerely

Nandeep

Thanks a lot professor.

It was wonderful class and learnt a lot.

Thanks
Varsha

Dear Dr. Paul G. Ranky,
Please see the URL to all my assignments for this course. It was nice having you with all the great resources in this class. Please keep up this great work. Hope to hear from you soon.

Regards,
Moses

Sir,
It's been a great 'ride' as I worked thru these challenges- thank you for these opportunities!

Cheers,

Jonathan

Awesome, I really learn a lot of important things applicable in my job.

Thanks,

Fabian
Comake Engineer Frozen for Savory Americas
Unilever Foods A2-086A

Thanks for a great semester, I enjoyed learning all of these new concepts!

Thanks,
Mary

Dear Professor,

I would like to thank you for your efforts in providing one of the best distance learning courses at NJIT. Like always, I feel very confident in submitting my coursework.

Best Regards,

Atif

Hello Dr. Ranky,

Once again thanks so much for putting this course together because it really helps me on my professional career. Also thanks to IE 673, i did so great in this concurrent engineering course.

Regards,
Bedwuine

Thank you for an eye-opening semester, both in regards to concurrent engineering and about working in .html!

Hope you have a good holiday!
Irene

Prof . I really enjoyed the course IE 655 and your an excellent professor. Your e-book and cd's helped me to go into the deep of real world and came to know about the facts and miracles in technology. For the reason I took one more e-learning class in spring 2008 i.e IE 673. I am confident that I can learn an lot from you and know better about the subject and applications.

Again Thank you for all your support and helping me in my success.
yours sincerely

Sunil

Thanks for a good semester, the course was definitely one of the most interesting and informative courses that I have taken.

Regards,

Steve

This is what one of my Japanese NJIT student has emailed me:

'After developing the CORA requirements model using the CORA Analysis Excel template provided by Dr.Ranky, Reckitt Benckiser (a USA-Japanese Company) and I, was able to identify where the company lie in the field of high-speed aerosol canning equipment after down sizing the equipment to 30%.

From the result, Reckitt Benckiser was first impressed with the result. As mentioned in the summary (assignment 0), Reckitt Benckiser is a global company trying to challenge its business in Japan where the resources are extremely tight with limited space. However, they were able to receive assistance from Chiron America, Delta Tau Delta Systems Automoblox, Romi Machine Tools. Ltd, Zobmondo!.

CORA template and Beta ver. Ranky-Taguchi calculation not only helped Reckitt Benckiser identify where they stand within the canning operation with competitors, but Reckitt Benckiser was also able to identify their strong and weak points. Reckitt Benckiser now has a better understanding of what areas need work and what area needs the most attention for continuation of their success.

Reckitt Benckiser understands the importance of this analysis and will continue to research those weak areas identified in the analysis and eventually surpass those competitors.

In my opinion, it is amazing how important CORA template can be applied for a company. I was able to assist Reckitt Benckiser by combining the importance from both the customer and technical point of view.

What's amazing is that this template can be used for any operations in any industry. The CORA template is like having thousands pages of documents into one clean easy to understand template. This is definitely a great tool for one to learn. Thank you Dr. Ranky. '

Sincerely,
Kotaro
IE655 NJIT student in Japan

'Hi Prof., I did recommend your classes (IE673) and (IE655) to one of my friends at work, who is doing the M.S. in Engineering Management, and he is going to take them both. It has been a great learning experience. One of the things, I have to admit that if it wasn't for you, I would probably never learn how to design a web page, and think it is a complicated process. (thank you). Nirmin'

Thanks Professor,
A lot of thanks for educating me in TQM(IE673) and CE(IE655). It is very helpful in my professional development!

I was nominated in two categories: "Best Product of the 2006 Year" and " The Best Team" between all Stryker divisions.

Thanks and regards,
Abram

Professor Ranky:

I would like to express that I admire your way of teaching. I have to admit that I learn a lot of interesting topics and subjects during the Summer of 2005 through "Cuncurrent Engineering" and this Fall through "Total Quality Management", not to mention that I learned how to create the website and post my assignments on it which I had no clue about it before.

The good thing that I can apply use all of what I learned in my work (in small scale) and even in my day life.

So. thank you very much.

Baher

Thank you again for all of your time and help, it is greatly appreciated. Renee

---

Thanks for having you as a teacher and I wish you happy holidays.
Best regards, William

Thanks! I enjoyed the course… actually learned quite a bit that is very practical to my work at Rolls Royce!

I do find the methods useful... they have helped me to understand a lot of what is going on around here.

Cheers,

Doug

I learned a lot from you. Thanks for the nice reference. Both the bank and the company will be extending offers to me sometime next week.
Thanks & Regards, Ashley

Thank you very much for an excellent semester... I feel that I am walking away with a lot of valuable information that I can utilize.
Regards, Matthew

Thank you for an interesting course this term. It has given me exposure to a number of tools that I will work to incorporate into the processes my staff and I work through now. With proper planning and review up front, I am confident that I will be able to improve the processes.
Thanks again. David

Dear Dr.Ranky,

I had graduated from NJIT with MS in Information systems in May 2003. I had taken the CIS-683 course with you in 2001.... The course which had enabled me to gain a good understanding of Simultaneous / Concurrent engineering, proved extremely valuable in my career as a Business Process consultant.

I have been working as a consultant with IBM for over 8 years, worked as a independant consultant for a year, and I am currently in the process of joining Citigroup as a CPI manager.

I am applying for MBA programs at the moment .....

Baiju Krishnan

Professor Ranky,
I am excited to be taking your class again. TQM (Spring 05 was excellent).

David Adwedaa

My response to these emails...

I have to admit, that student comments like the ones above make me not just incredibly happy, but also work harder every semester to give you the best and latest, and to continuously update and improve this course and the learning resources. I know it is popular because we all learn useful methods and tools, as well as see the REAL WORLD via virtual factory tours on videos, and then apply the analytical methods; I am delighted, that you like my 3D eBooks and digital videos too!

Note, that this is a combined **Welcome Letter and Course Outline** for both the live, as well as the distance learning class. Please read it carefully. You will find all essential course information here.

Please note, that this document will be updated during the semester. If anything is unclear please contact me (email is best: ranky@njit.edu). According to NJIT's policies, in this course the NJIT Honor Code will be upheld, and that any violations will be brought to the immediate attention of the Dean of Students. Also, students will be consulted with by the instructor and must agree to any modifications or deviations from the syllabus throughout the course of the semester. As you will see, I fully believe in teamwork, because in a good team 2+2 = 5 (... and we need extra good hands in any project, don't we...).

On the other hand, I do not believe in copy-paste type of problem solving, because it does not add value, therefore nobody gains... therefore PLEASE

1. Read this syllabus carefully,

2. Follow the requirements accurately,

3. Do not copy neither from each other, nor from the web (there are over 10,000 IE655 CE student assignments on the web; developed by my students!), because if you do so you will not learn the material presented, and that is a loss,

4. Keep the deadlines, and

5. Always do your best. Don't ask me to be your computer that checks what is obvious, or reads the syllabus for you, or gives you facts from this syllabus... ask me to help to learn, progress and invent and I will always help you!

Some really useful advice about the style of professional communication...

Often I get some truly friendly emails from my students... many of these include SMS-style text messages, 'buddy language', such as 'hi paul, how r you doin...', etc.

Whilst I am flattered by your friendly communication style, there is something I must bring to your attention. At NJIT it is not just my job to teach you analytical skills, but also professional courtesy and conduct so that you become successful in the US and in international industry. (Of course I assume, that you want to be successful...)

For communication (emails) in my courses at NJIT you must observe the following:

- Address professors and staff appropriately (no informal language or first-name basis)
- Correct grammar (all capital letters are not acceptable, neither SMS abbreviations)
- Please use your NJIT registered name and email address; ALWAYS!

I hereby kindly inform you that these NJIT guidelines must be met in all electronic communication.

Regards,
Prof. Ranky

P.S.
Had I phrased my emails in a friendly SMS-style, or all in capital letters to my boss during my first job I would have been fired on

the spot... (For reference: I have never been fired...)

Contact Information...

Please note, that **this document might be updated** during the semester. PLEASE do NOT print it; view it on-line. If anything is unclear please contact me. See the contact details below:

Paul G. Ranky, PhD
Full Tenured Professor
Registered Chartered Professional Engineer
Member of the American Society for Quality (ASQ), Audit Division and Lean Enterprise / Advanced Manufacturing Division
Also Member of ASEE, IEEE, IEE, FEANI, SAE, PMI
IEEE Green Engineering Editor, Department of Mechanical and Industrial Engineering, and also a Professor of IT at NJIT
NJIT, University Heights, NJ 07102 -1982

Email at NJIT: ranky@njit.edu (Please note, that for reliability reasons I have added another email address: paul.ranky.njit.edu@mac.com . Sometimes the ranky@njit.edu email does not work, therefore we cannot communicate... in such cases we must have an alternative solution. Please use this paul.ranky.njit.edu@mac.com email and send your email again if you don't get an answer from me within **5 to 7 working days**. BUT there is NO NEED to DUPLICATE emails... I can read the paul.ranky.njit.edu@mac.com account over the Internet anywhere where I have Internet access, therefore even if I am away at a conference on NJIT business we can be in touch.)

In case of an emergency pls. email me; I try to look at my emails on my cell phone frequently, including weekends and holidays.)

Note, that my **office** is in ME 310 at NJIT, Newark Campus

My **office hours** for the semester will be Tuesdays from 5.30 to 6 pm in my ME310 office, and also on-line. Other office hrs. are also available by appointment only. Pls. keep me informed of your progress by email, and I'll be happy to see you as soon as I can if you need help. I answer emails 7 days a week, 14 hours a day. If you have a question or need help please email me first.

Find out more about **the Professor's past and current research work and background** at:
http://www.cimwareukandusa.com/aboutpgr.htm

What are Hybrid Courses? This course is suitable for international students to satisfy on-campus requirements...

Please note, that this course typically runs in eLearning hybrid format at NJIT.

hy·brid - noun *- something of mixed origin or composition; something, such as a computer or automobile plant, having two kinds of components that produce the same or similar results.*

Hybrid courses at NJIT, also known as blended or mixed mode courses, are courses in which a significant portion of the learning activities have been moved online and time traditionally spent in the classroom is reduced but not eliminated.

The goal of hybrid courses is to pair the best features of face-to-face teaching with the best options of online learning to promote active and independent learning and reduce class seat time.

Using instructional technologies, the hybrid model forces the redesign of some lecture or lab content into new online learning activities, such as case studies, tutorials, self-testing exercises, simulations, and online group collaborations.

This site (ref.: http://media.njit.edu/hybrid/) was created in support of NJIT's Pilot Program in Hybrid Learning and the Weekend University.

"Within five years, you'll see a very significant number of classes that are available in a hybrid fashion," says John R. Bourne, a professor of electrical and computer engineering at Franklin W. Olin College of Engineering who is editor of the Journal of Asynchronous Learning Networks. "I would guess that somewhere in the 80- to 90-percent range of classes could sometime become hybrid."

And he says he expects to see more students choose to take online courses even if they live on campus.
"Hybrid Teaching Seeks to End the Divide Between Traditional and Online Instruction" by Jeffrey R. Young, March 22, 2002,

Chronicle of Higher Education

Ref. for up-to-date notes on the subject: http://media.njit.edu/hybrid/

As always,

Happy Learning for REAL,

Professor Paul G Ranky, PhD

IMPORTANT NOTES TO ALL STUDENTS

Please read this new syllabus carefully. If anything is unclear let me know by email and I'll help: ranky@njit.edu

Please note, that I try to answer your emails within 1 day, but in case your email is not answered within 5 to 7 working days, depending on the number of students and therefore my workload in the given semester, it means that my response wasn't delivered due to email address / account issues at your end, or perhaps at the NJIT end... Sorry, You have to fix your side, I'll fix my side.

Also, if you are asking something, that is clearly described in the syllabus, I will probably not have the time to act as your computer and read it for you... therefore, due to my workload I will probably not have the time to respond to such trivial emails (e.g. 'prof. when is the deadline of assignment 1?, or 'where is your office at njit?'). Please note this and please read this syllabus carefully. THANKS! On the other hand if you have a REAL question, I will always be there for you.

Naturally my email at NJIT can fail too, as it has in the past. In this case either wait until NJIT resolves this problem, or or use my alt. email. Please note, that often I am away on research, in particular in the summer sessions, therefore email is still the best option.

Last year's statistics shows that over 80 percent of the questions asked by students about this course were actually answered in this combined Welcome Note/ Course Syllabus... therefore PLEASE READ it ... it saves time for all of us, most importantly for you!

Due to the fact that I teach and supervise typically over 120-130 graduate students every semester, I cannot confirm the receipt of your homework assignments, but when you get my comments and the grade you'll see that I am working on your assignments too. It is important that you prepare them as well as you can, on time. PLEASE note, that I will only tolerate lateness if there is a professional reason for it. You have to email me this professional reason BEFORE the deadline.

About improving and resubmitting assignments: Please note, that each assignment must be submitted on time. There is only one resubmission option and that is within the framework of the last assignment, that is the 5th assignment, at the end of the course when you have to submit all your improved assignments again (see later). Note, that if you are late submitting your assignment, then you loose the option of resubmitting a reworked version for a perhaps better grade. In other words, if you are late, do not submit your assignment, wait until the last assignment, and submit it with that.

PLEASE set up your own web page including your optional photo in the webpage, use NJIT's FREE web server, or your company's, or your own, or other solutions that work... (e.g. www.weebly.com is a user friendly and free solution). It is your choice what software you use, which service provider you chose, etc...

PLEASE submit ALL your assignments electronically. Since I deal with typically over 1200 assignments every semester **ALL YOUR ASSIGNMENTS MUST BE** submitted electronically, meaning a URL in an email, pointing to a web page. If you do this over the web, it becomes very easy after Assignment 0... you may email me assignment 0 as an attached Word file, nevertheless you should put it onto your web site as soon as you have learned how to create a website.

You can chose the software and web services... just make sure, that the service can handle links, including links to .XLS (i.e. Excel) files (NOT embedded into PDFs pls.), since your spreadsheets will be in this format... NJIT's free server option has this, www.weebly.com allows this, and many others do NOT offer this. Every semester this creates trouble for some, therefore pls. note this and make sure that all works fine!

Note, that some students create a simple content list and then attach every assignment in Word, or PDF... this is wrong practice. Please put the text into .HTML, the images into .JPG files and the spreadsheets into .XLS files.

IF your web page does not link due to a link error you get an automatic 0 grade for the assignment. Sorry, this is tough I know, but

teaches you attention to detail and the importance of testing your work... pls. ask a colleague, classmate to test your page from a DIFFERENT computer.

IF you ask me to sign in with a password then that is zero grade too. Sorry, I do not do that. This still means that you can rework this assignment and submit it again with the 5th assignment together for a better than zero grade, assuming you have submitted the first time around on time...

PLEASE do NOT use MS-Publisher as a web authoring tool, since according to the last 6 semester's experience it has linking problems even within an entirely MS 'industry standard' (or non-standard?) environment... not to mention the internationally accepted Internet community... 'If they cannot see your web pages then why to bother at all...' therefore make sure that your web pages are being used for knowledge collection and knowledge management and therefore are accessible from anywhere in the world!

Please make sure that your URL works before you send me an email with a full length URL in it so that I can click on it and directly link to your assignment(s). The best approach is to set up your own web page, and then copy-paste the requirements from this syllabus and then add every assignment to this URL as you develop them. This way you won't miss any aspect of any assignment. Also, this will be an extremely valuable knowledge documentation method to learn and resource when you apply for a job!

If you don't know how to set up a webpage I will help you during the first week of classes. Please let me know if you need help! (Pls. make an appointment via email.)

When you are done, you trigger my grading process by sending me an email with your URL in it. Again, submit it on due date, NOT earlier, NOT later pls. This helps my system a LOT!

In the SUBJECT SECTION of your email pls. specify your class code (e.g. IE655 Fall 2011, DL Class); this helps me too. THANKS!

As you post a new assignment PLEASE email me about this with the proper link (the full URL in the email, like this http//www.thisismywebpage.com, so that I can just click on it and I am at your webpage). Please do not put any passwords on your web site. Passwords are not safe anyway and it makes my life very difficult... and I will NOT look at your passworded assignment, and that means zero grade for the assignment... sorry.

In your emails, please use EXACTLY the same name you are known to NJIT at the time of registration. My roster goes by the FAMILY name (e.g. RANKY), NOT by the first name (e.g. Paul)... therefore I am NOT Dr. Paul, I am Dr. Ranky...

Often I see long names with nick names in emails, that are not in my roster, therefore takes me a long time to find you... and the more time I have to waste on stupid searches like this, the less time I have to teach you valuable things... so please do not use your nick name in your emails! Thanks!

IMPORTANT NOTE: THIS APPLIES FOR EACH ASSIGNMENT! If you are using an image / line diagram / video clip, or any other illustration in your assignments, then please note, that each image should have a caption, indicating the figure / image number, what it describes, and who has taken the image (i.e. the source of the image). As an example, consider this: *'Figure 123: This image illustrates a broken cell phone due to human error (image by myself: Mr/Ms. ABC)'.* If you are copy-pasting images / illustrations from your book or from the Internet, that has zero value, because those are not your original contributions! Try to create your own; always... no copy-pasting please! Please note, that **I would like to see many illustrations in your assignments,** that you have created. Nice, professionally done, good quality figures, pictures, line diagrams, even video clips, that are not copy-pasted from the book or the Internet, but created by you! I hope you agree, that an engineering manager should be able to do this...

Please note, that pass-worded student assignment web-sites and submissions are not accepted. Not even if it is the instructor's NJIT UCID and password that is needed to sign in (sorry, this is NJIT policy).

***We plan to use the* Highlander email-to-class system offered by NJIT, therefore pls. READ the email address you have offered to NJIT, ELSE I CANNOT BE IN TOUCH WITH YOU BY EMAIL; since this is the ONLY email my NJIT system knows about you (even if you have 6 others... hope all challenges are clear...) Please note, that via Highlander you can network to your entire class too and social network. Please do NOT change your name, or email when you are corersponding with me. Please use your NJIT known name and email. Thanks!**

The NJIT Honor Code will be upheld, and any violations will be brought to the immediate attention of the Dean of Students. Students will be made aware of any modifications or deviations from the syllabus throughout the course of the semester. IF you copy versus develop your novel assignments then you'll get zero garde points for copying... sorry copying others' work will not get you anywhere in our global competitive world... just see all those legal IP cases when companies copy servers, software, products, procedures, T shirt designs, watches, etc. Trust me you DO NOT want to go that way... dead end for loosers... you want to win, drive the future and you CAN!

SOCIAL NETWORKING and Video Conferencing: During the semester, I will email you several links to short technical articles, that are really important for you to follow and understand what is going on in the world in our subject area. This is particularly important to some foreign students who are not used to get their news via the Internet. You suppose to chose three of these articles (for every assignment, as well as the Midterm) and then discuss at least THREE (3) of them with at least one more member in your class, and then document your findings in your social networking part of EACH assignment. I would like to see that you are discussing the content of these articles. Usually in a semester I send out about 40-45 short and current articles to chose from. Through my editorial work with major journals I get hundreds of *just published* articles that I can choose from... I am looking for your executive summaries of the discussions you have documented with one or more of your classmates via tel., email, in-person, and/or video conferencing. These activities are all part of each assignment now and therefore should be documented in your web page as an executive summary, just as the rest of your assignments are. The detailed discussions of these articles could be saved on Moodle, or anywhere else (your choice), in a digital format. Your executive summaty in your assignment should hyperlink to the detailed discussions (where ever you have stored them). All in one; nice object-oriented principle; not zillions of separate files please! Since this is often misunderstood, let me repeat again: in other words, you read several articles I am sending you but you document only three of them per assignment. (Again, you don't have to read all of them and don't have to document all of them.)

Please note, that this is a good definition of what an 'Executive Summary' is: From Wikipedia, the free encyclopedia:
An executive summary, sometimes known as a management summary, is a short document or section of a document, produced for business purposes, that summarizes a longer report or proposal or a group of related reports in such a way that readers can rapidly become acquainted with a large body of material without having to read it all. It usually contains a brief statement of the problem or proposal covered in the major document(s), background information, concise analysis and main conclusions. It is intended as an aid to decision-making by managers and has been described as possibly the most important part of a business plan. They must be short and to the point. An executive summary differs from an abstract in that an abstract will usually be shorter and is intended to provide a neutral overview or orientation rather than being a condensed version of the full document. Abstracts are extensively used in academic research where the concept of the executive summary would be meaningless. "An abstract is a brief summarizing statement... read by parties who are trying to decide whether or not to read the main document", while "an executive summary, unlike an abstract, is a document in miniature that may be read in place of the longer document".

IN case of an INCOMPLETE: In the case you file for an 'I' incomplete at the end or during this course, due to a professional reason (pls. see the NJIT regulations an definitions), and in case you don't want that 'I' to automatically turn into an 'F', as the NJIT computer does this, PLEASE submit all your work at least 30 days BEFORE the end of the following semester. This gives me enough time to evaluate your work, grade you, and also NJIT to deal with all necessary paperwork to change your grade. AGAIN, pls. do it as above, else I might not be able to do it before the NJIT deadlines... it is better to plan this properly than be upset when it is too late... Thanks!

These are the steps my students suggested in the past to follow when uploading webpages to the NJIT server (Note: I use professional servers and professional software tools; I do not use the NJIT server, therefore if you need help in terms of VPN (Virtual Private Network) links, or how to download software from the NJIT website, or why your webpage does not work with the FTP (File Transfer Protocol Program NJIT offers) PLEASE contact the NJIT computing helpdesk, NOT me. Also suggest, that you network with other students in the class, or via chatgroups (instant messaging systems); I will help in this as much as I can by emailing these important links to everybody during the first week of class, as soon as I get the class roster from NJIT's Registrar.

1. **As an NJIT undergraduate, graduate, live and/ or Distance learning, or in other words eLearning Student, or hybrid course student you are entitled to benefit of significant FREE computing resources**, meaning hardware, lots of free software, as well as on-line email, web-site storage space, and related Internet and NJIT intranet server services. The steps below intend to help you on how to set up a web page for documenting your assignments for this course. Please read and follow each step. Obviously if you already have a web page, either through work, or business, or otherwise, please feel free to use that, or the one you prefer. (All we want is for you to learn the method, and then put all your assignments on the web, learn how to manage your knowledge over the web, and then email your URL with your assignments to the instructor for grading). Note, that you can use any suitable web authoring software. NJIT has a few too.

2. **These are the steps to follow (as provided by NJIT's IT and Computing Services):**

   Hopefully all works... I'd like to see your beautiful webpages!

   1. Visit: http://csd.njit.edu/resources/webservices.php and read the instructions for Home page Setup. If you don't understand the details offered, please contact NJIT Academic Computing at Tel: (973)-596-2900, and they'll take you through. (Note, that lines can be busy during peak times, such as at the beginning of the semester, or towards the end of the semester, therefore to sort this out the earlier the better!)
   2. You should have an index.html file as your 'title page', because search engines will find you via the index.html file, and your hyper links to other files should be programmed passing through this index.html file.
   3. Please make sure, that you create your index.html file in your public_html directory and have all your other .html, .jpg, .xlx, .mov, etc. files in the same directory, else you will have a 'path error', meaning that your files will not link when viewed by others over the Internet.

4. Last, but not least: **ALWAYS test your uploaded assignment** using your own, as well as somebody else's computer, to make sure, that everything works fine. (If you don't have a second, independent computer on the web, ask one of your classmates, or friends to check it for you, by sending him/her an email with a full URL in it, like this: http://www.mycoursewebpage.edu). Also note, that besides the class discussions (live class), the eLearning pack CDs have several examples on the architecture of simple and complex web-pages. All of these are in open source, please study them! We'll discuss some of this in class too!

3. **One of my students offered this explanation on how to upload webpages to the NJIT server:** (new version: October 27, 2005 state; might have changed since then...) Click to see it in .html (Suggest you use www.weebly.com as the easiest solution.)

   Also, another student of mine suggests to use Netscape for free webpage design. This is the link: Netscape 7.2 is free for download for both PC and Mac at the following URL:

   http://browser.netscape.com/ns8/download/archive72x.jsp

   Last, but not least: **ALWAYS test your uploaded assignment** using your own, as well as somebody else's computer, to make sure that everything works fine. (Also, ask one of your classmates, or friends to check it for you, by sending him/her an email with a full URL in it, like this: http://www.mycoursewebpage.edu. Always include the full URL into the email, else it won't link directly).

   Also note, that besides the class discussions (live class), the eLearning pack eBooks have several examples on the architecture of simple and complex web-pages. All of these are in open source, please study them! (Note, that open-source does not mean that you can upload an entire eBook of mine, or video onto a server on the web. This would be a major copyright violation!!!! Try to stay out of legal trouble, USA lawyers are the best... PLEASE!)

4. **The 21st Century Engineer must be a professional information searcher, information and NEW knowledge creator, as well as somebody who can reason over several different sets of information and then select** the best possible solution path under constraints... You should be able to question, interrogate and take optimal decisions... not an easy task. In order to help this process, in this course we'll visit NJIT's wast and advanced electronic library, see some of the typical information searches and how the results can be evaluated. For our purposes, we'll use NJIT's SCOPUS electronic database. You can reach it via: http://www.scopus.com.libdb.njit.edu:8888/scopus/home.url, all you need is your UCID and password (as offered by NJIT to every NJIT student) to access this site

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Contents (IE655) Course All Options: Live, Hybrid and Distance Learning (DL, or eLearning, the same).

Technologies Study (**20% max.**) **Note: deadlines are strict! Deadline: November 15, 11.59 pm. Please email me your assignment link on this day. NOT earlier and NOT later. If you are late, you are loosing the rework option. PLEASE note, that Assignments 3 and 4 are graded together for academic reasons.**

- Class 13
- Class 14
- Class 15 **Assignment No. 5:** Concurrent Engineering / Green PLM Product Design Assessment and Improvements: a product/process design of your choice, a green product design review process and marketing plan (Press Release of your new product/process/service), and Video-conference with a class-mate over the Internet using free SKYPE, or another app or tool (**30% max.**) **Note: deadlines are strict! Deadline: December 11, 11.59 pm. Please email me your assignment link on this day. NOT earlier and NOT later. Please note, that you'll be graded on what I have on this day.** In this case I cannot offer you any extension, due to NJIT regulations.

For ALL assignments: Please note, that if your are late with the submission of an assignment, then you can only submit it together with the last, i.e. the 5th Assignment. In other words if you are late with an assignment, you are missing a rework opportunity based on my comments. You can resubmit the improved version of each assignment once, assuming you have submitted each of them on time, i.e. on due date (as above).

NJIT IE 655

Welcome to IE655: one of the most useful green engineering / engineering management, green PLM (Product Lifecycle Management) courses you'll ever take! Please read these notes and work hard on your assignments. What you'll learn in this class will help you to be amongst those who will continously win and prosper. If anything is unclear please call me or email me. I am here to help you!

In IE655 we discuss and learn a conceptual, as well as a practical approach how to innovate, and minimize the time required to successfully execute complex **product / process / resource design focused projects**. We'll also learn how to create **Sustainable GREEN products within a Sustainable GREEN PLM process.** Techniques utilized and discussed in detail include lean-six-sigma design systems analysis and integration principles, needs analysis, following QDF (Quality Function Deployment) - like methods and tools, product modeling, system modeling, process risk analysis following FMEA (Failure Mode and Effects Analysis) concepts and tools, Taguchi design of experiments methods and tools, Weibull reliability analysis methods and tools, collaboration and integration methods, rapid prototyping, digital design & digital manufacturing, design for manufacturing / assembly, design for the environment, eco-friendly designs, and others.

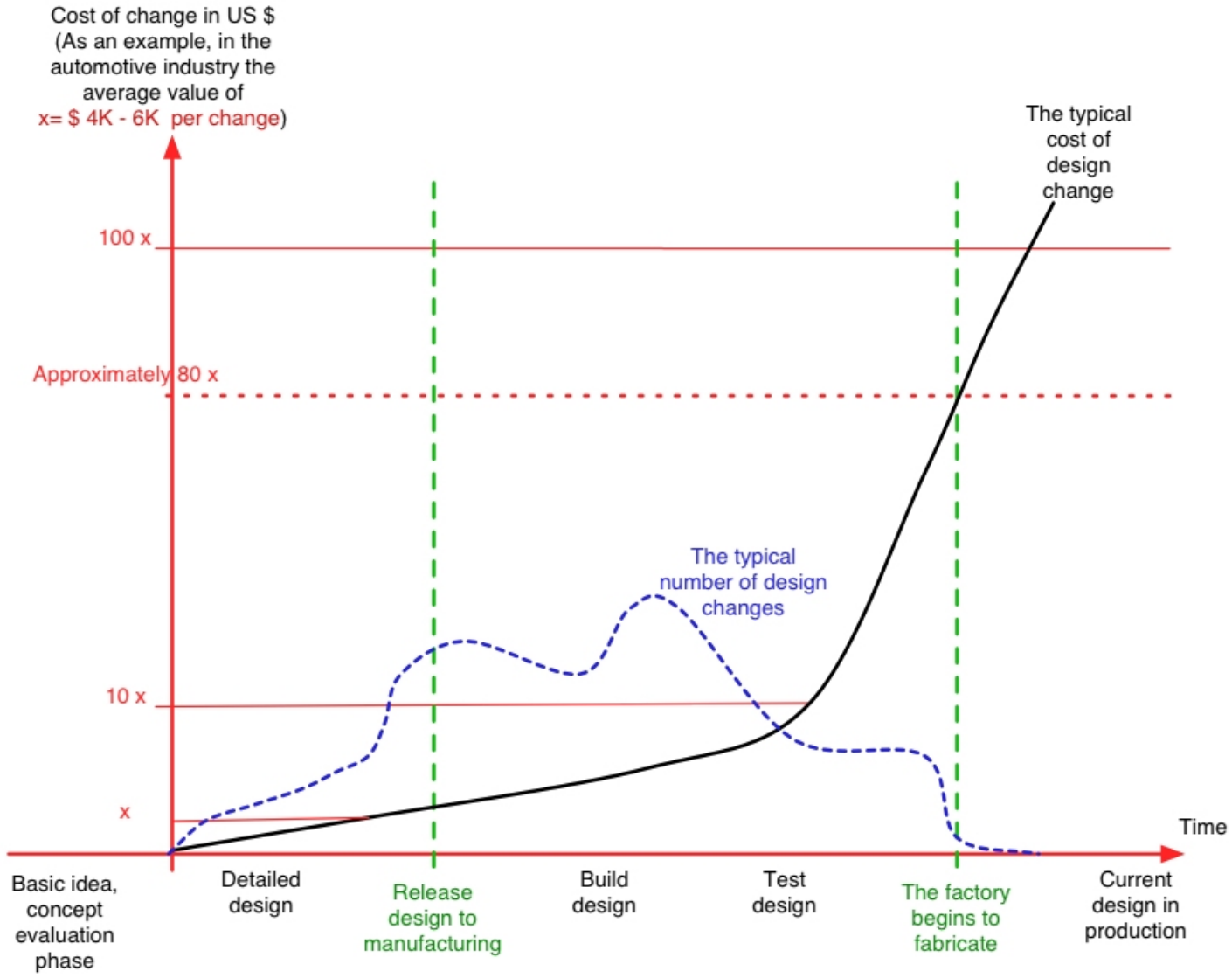
Relevant open source software is employed and made available to students in the form of a customized eLearning Pack, and commercial software for educational purposes via the NJIT servers. The course should be of interest to individuals concerned with integrated product/ process innovation, sustainable green design and manufacture, and product introduction to the market, minimizing lead time, reducing project development cost and time to market new products, and/or services during multiple lifecycles.

Narrative Description of the Course
An object - oriented (i.e. modular product, process, service design) lean-six-sigma approach to the introduction of various product and process design methods, tools, technologies and their management issues within a variety of small, medium and large enterprises for the purpose of reducing lead time, and cutting waste.

The purpose of concurrent / simultaneous engineering and green PLM (Product Lifecycle Management) methods is to cut product and/or service process development lead time, to reduce waste, to reduce the number of costly product design changes, to improve quality, and to create a lean workflow. This is applied from concept to integrated product/process design, manufacture, assembly, maintenance and after-sales support, based on analytically established customer requirements, and process models.

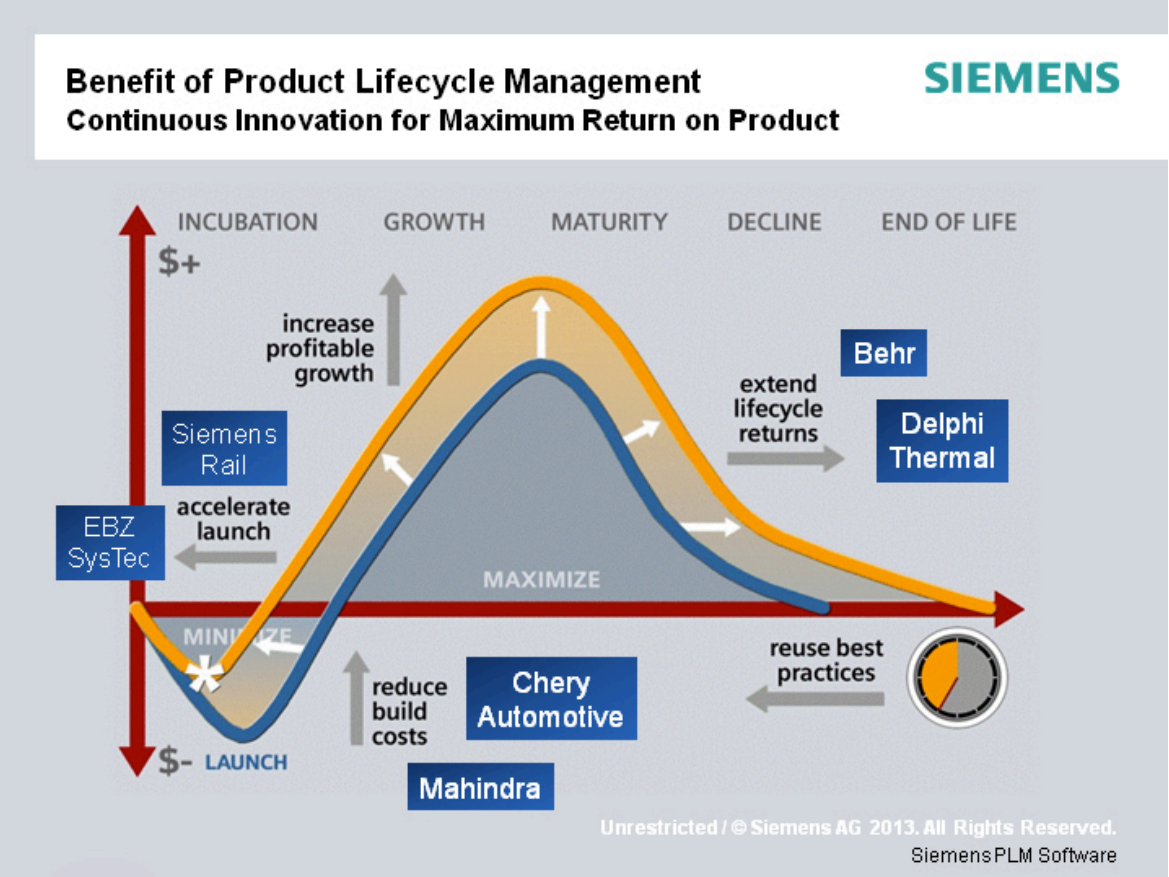
The diagram below clearly illustrates the essence of this course. As it can be seen, it is every company's aim to innovate, create new products, processes and services that are required by customers, that are high quality, and can be introduced to the market at a competitive price.

The diagram below clearly illustrates the extremely high cost of product design changes. This is typical without deploying concurrent engineering / PLM methods... in the IE655 class we'll learn methods, tools and technologies, that will lead us to innovate, and minimize the number, and therefore reduce the cost of changes during the entire lifecycle of a product (hence the terminology: PLM).



Furthermore, as illustrated below, it is important to understand, that Concurrent Engineering, combined with green, sutainable PLM, Digital Design and Digital Manufacturing, Total Quality Management, Decision Analysis Methods and Project Management offers major product life-cycle cost reductions, as well as quality improvements.. (i.e. lower cost, higher quality = win for all!) .

As you can see below, as well as in our advanced, digital course material (pls. refer to the eLearning Pack collaborative companies, as well as the 3D multimedia eBook, and the digital videos in your eLearning Packs), small, medium, as well as large companies, like Siemens are not just talking about Concurrent / Simultaneous Engineering and Sustainable Green PLM (Product Lifecycle Management), but actually practicing it! This is because of the huge benefits they can gain by doing so.... and most importantly you will learn about these in this course, in detail... so, that you'll be ready working for them as a well prepared professional engineer!



Furthermore, as you study the graph above and below, consider the following:

In engineering systems the term 'life-cycle cost' means the sum of all the costs, both recurring as well as non-recurring, related to product, structure, system, process, IT, and/or service during its life span. (A typical life-cycle is illustrated below.)

As you can see from this graph, life-cycles typically start by identifying a customer need, a requirement, a want, a desire, and/or a sound business opportunity, and end with product/process retirement, conversion, re-engineering, recycling and eventual disposal activities. (Note, that in the case of a modern, environmentally friendly concurrently engineered product/process design system, 85-90% of products are eventually re-used and recycled.

Since by understanding the underlying drivers and processes of concurrent engineering, the opportunities for saving valuable product/process design and development cost and time are huge, the aim is obviously close to 100% re-use and re-cycling, and as we will discuss this issue in the course, there are already good examples for achieving this goal...

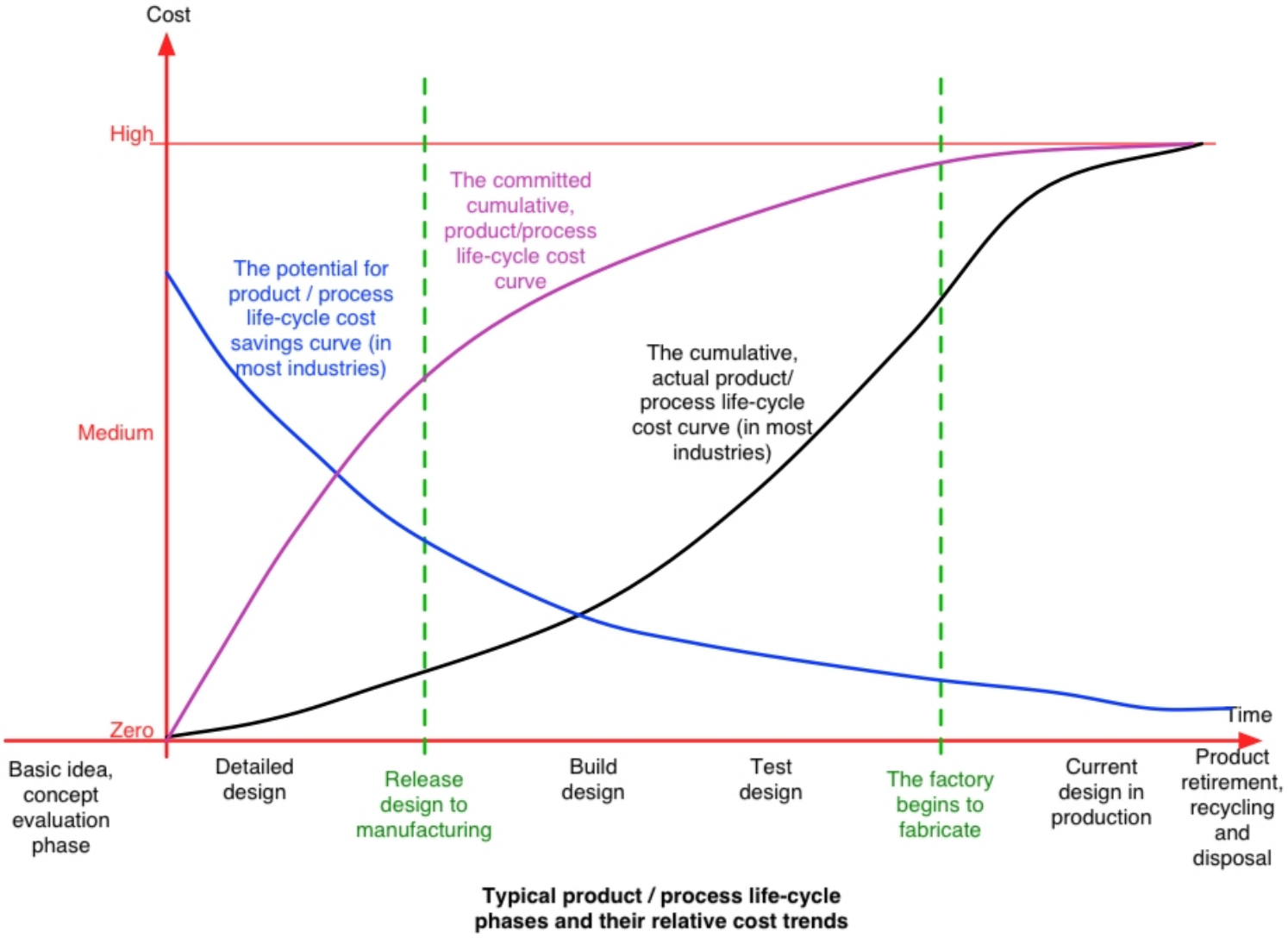
Besides others, the graph below underlines the fact, that concurrent engineering economic studies, process-by-process cost and gain assessments are essential part of the big picture, because they help to analyse and compare alternatives in virtual environments, costing a lot less than real-world experimentation on the shop floor when the product/process is already in full swing production and the commited costs are already high.

We can furthermore see, that the greatest savings occur at the acquisition phase, in other words around the basic idea to detailed design transition phase. This is why a factory with a future (i.e. a digital, networked factory) will have to understand and master concurrent engineering, PLM and NPI&I (New Product & Process Innovation & Introduction) methods and apply them at all stages of the business to be able to successfully compete.

It is also important to recognize, that as shown below, the commited cummulative life-cycle cost curve increases rapidly during the *basic product/process idea to detailed design* transition phase. In general typically 80% of life-cycle costs are 'locked in' at the end of this phase and at the beginning of the 'release design to manufacturing' phase by the decisions made during the requirements analysis, preliminary and detailed design phases. As illustrated by the **cummulative, actual life-cycle cost curve**, only about 20% of actual costs occur during the acquisition phase, in other words around the *basic idea to detailed design* transition phase, with about 80% being occured at the *product construction, operation* phase.

The conclusion is, as shown below, that the concurrently engineered NPI&I activity must understand the potential for product /

process life-cycle savings in all processes, with their requirements and risks involved. This should include their time and cost demands too. The key then is to simulate these issues in advanced virtual (digital) environments, and take decisions as early as possible (i.e. 'front loading') to avoid dead-end paths and costly changes downstream... easier said than done! (Note, that this statement is true for every product/process, IT, and service product development activity!)



Typical product / process life-cycle phases and their relative cost trends

It is interesting to see, that the above illustrated principles apply to literally every industry, but most importantly to all product, process and service design and manufacturing / assembly industries, as well as to IT/IS (Information Technology and Information Systems Engineering) and even to pure service environments (like running a hotel, or a bank, or a ski resort, or dive operation). As an example, in the IT industry the opportunities for savings are enormous, due to the fact that over 85% of IT projects fail (1990-2004 figures). This is costing the USA economy over 56 billion (!) USA dollars.

Using concurrent engineering and NPI&I methods this amazing level of failure can be reduced significantly (as a reference only 10-15% of engineering projects fail, and when they fail mostly they overrun, rather than truly fail, like don't work... or crash like software often does...). The major challenge though is to convince IT professionals to actually learn, understand and then apply these methods during their everyday work, versus jump into code-writing, clicking... as many of them do even now as you read this text... and they are charging for every click with the mouse... big $$$$...

Of course, the root cause is to convince many (not all) computing and information sciences professors to change the way they teach IT, information sciences, software design and computer programming... but this is outside the scope of this class... Nevertheless any fool can see that even if we could just save 10% of the $ 56 billion, we could gain $ 5.6 billion every year; not an

ignorable sum... the potential savings of course are at least 80% of the 85% failure, therefore we really talk about saving 80% of $ 56 billion = $ 44.8 billion USA Dollars in the USA only... World-wide this figure is estimated to be several times this value... imagine how many hungry kids we could feed out of this money... and how many could get university level education... now you feel the pressure; amazing but all true!

To move on with some positive thoughts, as seen below, the good news is that the above discussed challenges are recognized by many. The Design for Manufacturing (DFM) / Concurrent Engineering (CE) / PLM software market is forecast to grow very agressively not only in the mechanical (like the automotive) but also in the electrical, and electro-mechanical industries.

This is because the electronics industry recognizes the significant cost saving, quality improvement, and time-to-market reduction opportunities with CE.

As an example, at a recent Design for Manufacturability conference in San Diego, CA, USA, the electronic engineering community expressed their views, that 'DFM / CE / PLM solutions have emerged to help designers to cope with process variability reductions and yield increase' (... hope you recognize the link here with what we teach in Total Quality Management, IE673).

As EE Times, the industry newspaper for electronic engineers and technical management (by United Business Media, USA) reports in their June 14, 2004 issue, 'taking one of the boldest steps yet to merge design with manufaturing, Magma Design Automation Inc., USA announced an integrated solution...' Furthermore, IBM and academic research partners are working on methodologies for manufacturing-driven design rule exploration, physical verification, design rule checking (DRC), and other hot CE topics... As Vasilios Gerousis, Chief Scientist at Infineon Technologies AG put it: 'Design and process parameters need to be adjusted at the same time'; a clear success for concurrent / simultaneous engineering principles!

In order to lead the above outlined plan, with this course, our students are prepared for this challenge and are educated to respond to the rapidly growing employment opportunities in the field of concurrent / integrated product / process, PLM and service system design engineering management.

In the IE655 course we learn several well established methods in-depth, such as quality function deployment, requirements analysis, collaborative concurrent engineering (and service) process modeling, process failure mode and risk analysis methods, Poke-Yoke, Kanzei, rapid prototyping methods, PLM (Product Lifecycle Management), NPI & I (New Product Innovation and Introduction), and others, including methods, tools and technologies in the product / process / service system design field, covering the following:

- How to identify opportunities early, measure their impact and pursue the best possible alternatives ?
- How to deliver against focused objectives ?
- How to advance in new product development ?
- How to start a product development process / team ?
- How to achieve competitive edge ?
- How to re-engineer the organization for digital factory and networked enterprise design management ?
- How to manage change ?
- How to develop metrics, that can capture the potential for long term growth ?
- How to maintain innovation and cost control ?
- How to take advantage of digital design & digital manufacturing (PLM) methods and technologies ?
- How to front-load the entire product development process and gain over competitors ?
- How to integrate sustainable green product / process design methods?
- How to decide wheter it makes sense to outsource or not, and many others.
- How to collaborate on a design issue with a local and global team via email and video-conferencing, and the web.
- How to develop design reviews and discuss issues over the web in a global team.
- How to create ethical and plesent professional work environments in which positive creative thoughts and energies dominate... and
- Others...

The course is supported by a comprehensive eLearning package (this pack is the same for live, hybrid and distance learning students) with some printed material, and several web-browser readable, open source 3D interactive multimedia eBook CD-ROMs/DVD-ROMs, and DVD / digital videos. It includes real-world research and industrial case studies documented using 2D and 3D interactive multimedia, as well as open source, professional active code and spreadsheets, that the students can customize when developing their assignments with their own data.

To summarize, the methods taught in this course are relevant not just to innovative product design, manufacture, test and quality control of products, but to a large variety of services too, because they reduce development costs, and improve working capital management, by offering powerful methods and software tools.

Upon completing this program of study the candidates will be able to understand Concurrent/ Simultaneous Engineering, and

related PLM, Digital Design & Manufacturing, NPI&I, and total quality engineering management methods and tools. Note, that besides the above, **in this semester we'll specifically focus on PLM / Digital Design & Digital Manufacturing.**

Why is this course needed?
There are many methods and solutions to innovate and develop new green and sustainable quality products and processes, to cut down waste and to improve an organization, a design office, a manufacturing enterprise, or a product. One major discipline is Concurrent Engineering (CE). CE is also widely known as Simultaneous, or Parallel Engineering, and lately referred to as PLM (Product Lifecycle Management) reflecting the fact that in our knowledge age we are dealing with digital factories networked all around the world.... exciting, but also challenging...

Concurrent Engineering represents a structured, logical framework which supports a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. CE and PLM also underlines the importance of integrated engineering.

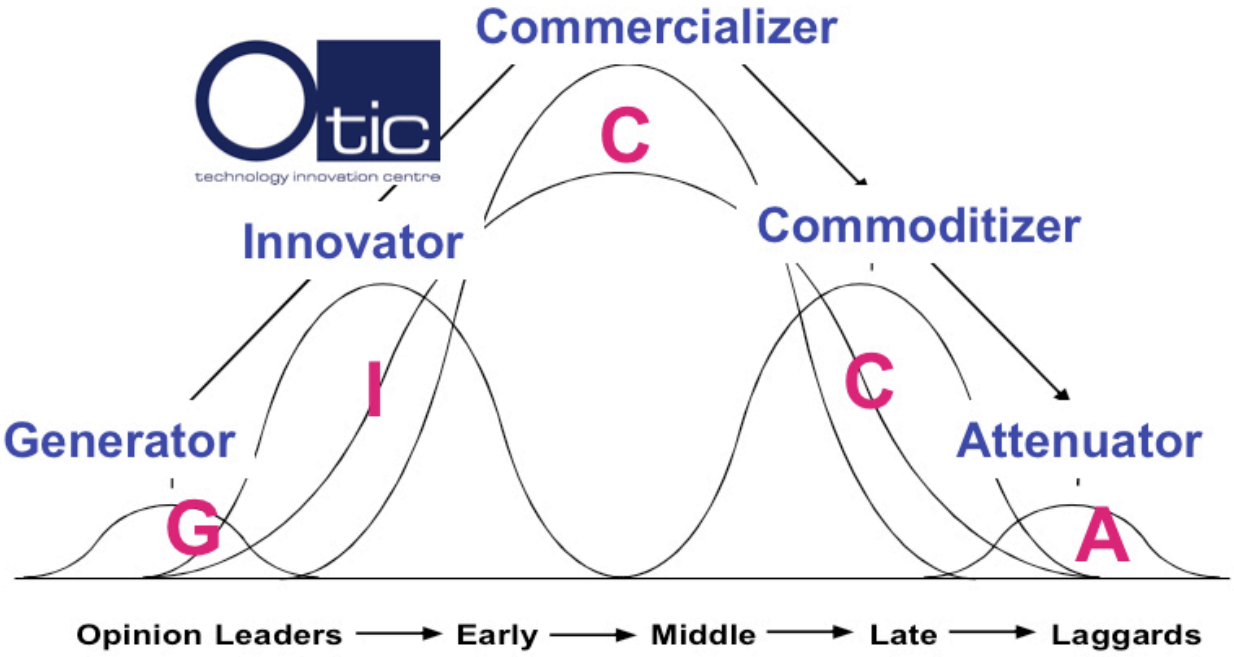
According to the USA-based Aberdeen Group *the key business pressures companies face include the following: Shorten time to market = 90%; Reduced development budgets = 38%; Increased product comlexity = 30%; Accelerated product customization = 15%; Increased quality-related costs, such as warranty, etc.* The solution is obviously Sustainable Green PLM, the core subject area of this (IE655) Course!

As a US-based BMW senior engineer with a PhD degree in engineering stated at the SAE Automotive World Conference in Detroit (April 2007): *'BMW prefers to employ engineers who have both design as well as manufacturing experiences... We, at BMW, firmly believe, that one cannot design quality automobiles without having an integrated engineering approach...'* (And of course, this integrated approach is what we communicate in this course as CE and PLM...)

The CE/PLM method is intended to ensure that developers consider all elements of the product life cycle from conception through to final disposal, and re-engineering / recycling, including quality, cost schedule and user requirements. In contrast to the old, conventional, or sequential product design method, Concurrent Engineering and PLM focus on customer satisfaction, on teamwork as well as on Design for Manufacturing, Design for Assembly, Quality and Total Lifecycle issues.

We further illustrate this concept with Dr. Peter Rayson's GICCA enterprise lifecycle curve (Technology Innovation Centre, University of Central England, Birmingham, UK).

Your Processes, Products, Knowledge and Technology will all exist at different phases of the **GICCA** Lifecycle curve



As it can be seen from the figure above, and below, it is essential to understand that none of the Concurrent Engineering or CIM (Computer Integrated Manufacturing) methods work in practice unless they are applied to all levels of the enterprise, that they are introduced gradually and that they are managed by people who understand and support them. (In order to promote this thought CIM, or Computer Integrated Manufacturing is now often referred to as the lean, or agile, or adaptive, digital manufacturing and design system, preferably implemented in a digital factory (more on this topic in a web-article...).

It is furthermore obvious from the table below, that the extended enterprise (with a future) must focus on all aspects of product / process and service system innovation and introduction to the international marketplace.

This process needs **knowledgeable and empowered individuals** who understand the importance of enterprise knowledge management, digital design & digital manufacturing, exactly the professionals industry needs, and this course aims to develop! (See the interesting table offered below by Peter Rayson, TIC, University of Birmingham, UK.)

Note, that various views and angles of this complex topic is addressed by Ranky in this Concurrent / Simultaneous Engineering / Green PLM course, in his Total Quality Management class, and also in his Decision Analysis, Project Management and Lean, Flexible Automation / Manufacturing Systems Engineering classes.

Market Facing Systems

Extended Enterprise	Customer & Supplier Transactions	Marketing Communications	Ecosystem Development	**Market-Facing Systems**
Integrated Enterprise	Enterprise Data Systems & Apps	Enterprise wide Communication	**Enterprise Knowledge Management**	Enterprise Process Innovation
Automated workgroup	WorkGroup Data Systems & Apps	**WorkGroup Communication**	WorkGroup Collaboration	WorkGroup Process Innovation
Empowered Individual	**Data creation access & usage**	Information Access & Authoring	Training, Education & Expertise	Workflow Integration
	(Structured) Data	(Unstructured) Information	(Unstructured) Knowledge	(Semi-structured) Work

Source: enterprise.com,
Jeff Papows, President and CEO, Lotus

tic technology innovation centre

UCE Birmingham

In broader terms, the aims of CE, Green PLM, or integrated lean, or agile, or adaptive, 3D digital design and digital manufacturing are very clear: get rid of waste, reduce the number of costly changes, eliminate toxic materials and processes as you green your product and manufacturing / assemnbly, integrae product and process engineering better, focus on high quality at low cost, offer product data management and Green PLM within all the companies involved in the product creation and manufacturing processes, organize our knowledge in our minds, and help us to focus on new innovative opportunities driven by the customer. The key is to be able to integrate the

- **Information flow**, meaning objects, and object classes communicating with each other, the
- **Material flow**, meaning actual material or information about material being moved in design studios, in the factory, as well as between globally networked factories, in global supply chains, and the
- **Processes**, such as design, manufacturing, marketing, quality control, and others, in our digital factories (i.e. the internal and external supply chains) in order to create wealth for several product life-cycles.

In other words, CIM (Computer Integrated Manufacturing), Total Quality Management, Engineering Project Management and Concurrent Engineering, and PLM (Product Lifecycle Management) address the whole enterprise, including products, processes, controls and resources, enabled and created by humans, machines and networked global partners, including the business systems, product design, process planning, manufacturing planning, the shop floor, packaging and maintenance via the internal, as well as the external supply chains.

As we can see when we analyze successful companies, innovative, quality design is very important: As an example look at Toyota, BMW, DENSO, Nissan, Honda, Boeing, Airbus, Dassault Systemes, or another giant industry innovator: Apple Computers. (Note, that in 2011 Apple Inc. became the most valuable USA corporation...(Certainly the iPhone, Mac, iPad is copied almost by everybody with limited success... there are over 3000 illegal Apple stores in China selling copy iPhones, and other so called 'Apple' products...). But when companies copy IP by definition they are behind by at least 2-3 cycles, nevertheless they can make substantial amount of money illegally... the problem with this is, that this illegal IP copying movement kills innovation... pls. think about it: How would you like your IP being copied and sold by others giving you ZERO... something you worked for years 14 hrs a day? (I hope you get my point...)

Engineering excellence is central to Apple's vision: Apple's leader, Steve Jobs, in **Paris at the Apple Expo 2005** talked about the beating heart at the centre of Apple's core, the company's world-class engineering teams.

"At its core Apple has great engineering and confidence that it has the ability to take complex technology and make it easy for the end user." Remaining relevant in a changing world is critical. The idea of making powerful technologies easy to use matters: "That need is becoming more necessasry as technology becomes more complex", he said.

"Apple does that better than any other company in the world. What makes us different? Most of our competitors don't have engineers anymore. Everyone else designs in the Far East."

Given that claim, a question was asked as to why Apple says "designed in California", rather than "designed in the US" on its products. Jobs responded: "(It's) because we like California. It is where we are from. It's not because we are ashamed by the US".

As you can see from Steve Job's comment, Apple truly understands the importance of culture being part of any integrated product, process and/or service design... several other CEOs only look at cost and then outsource... this is because most CEOs are not engineers and they just don't understand the importance of systems integration and culture being part of all this... not just the short term revenue logic...

The October 24th **Time Magazine** issue features Steve Jobs on the Cover holding a Video iPod and an iMac with the words "What's Next". (The article is available to subscribers, but is also available in full at TimeCanada).

In it, Jobs talks about how and why Apple continues to be innovative in this industry. He points to their product development cycle as "deep collaboration" or "concurrent engineering". Products don't pass from team to team. Instead products are developed in parallel by all departments "in endless rounds of interdisciplinary design reviews".

Jobs also places emphasis on control. Through controlling the hardware and software, integration can be more seamless. This also reduces your dependance on third party companies. The iPod, iTunes, iTunes Music store is an example of this control and integration.

The product now is the iTunes Music Store and iTunes and the iPod and the software that goes on the iPod. A lot of companies don't really have control, or they can't really work in a collaborative way to truly make a system. We're really about a system.

Jobs also provides more insight into his opinion about the new video capabilities of the iPod:

"There is no market today for portable video," he says. "We're going to sell millions of these to people who want to play their music, and video is going to come along for the ride. Anyone who wants to put out video content will put it out for this. And we'll find out what happens."

... and some more facts about Apple (to underline the fact, that concurrent engineering principles, as the CEO has identified the key, works well), as Apple is heading to become a $20 billion corporation:

- Net Mac sales increased 27% year over year
- Average price of a Mac fell 7%
- 21% year over year growth in sales in higher education
- 11% growth in K-12
- 28 Million iPods sold with 248% revenue increase year over year
- 38 new brick and mortar retail stores were openned in 2005
- Retail sales almost doubled to $2.4 billion
- Research and Development increased (up 9%)

Ranky: Well, this is what happened: within 2 weeks of the introduction of the first Video iPod, Apple sold 1 million videos for it over the iTunes music store, and within 1 year the music iPod gained 60% market share in Japan... where Sony and others typically rule... Apple's market share of the same product in the USA is over 85% for downloads, and 75% for hardware devices... real success, and real concurrent engineering methods... and you can learn many of these in this class.

I firmly believe, that the key to all this is the following:

1. A good, successful design is based on culture, created by progressive thinkers (i.e. HUMANS!), and the

2. Methods and toolset MUST have a strong emphasis on integration, like Concurrent Engineering, TQM and PLM. Isolated thinkers, with isolated tools will NOT succeed in our complex, networked, global infrastructure of creators, producers, manufacturers, and consumers. (In other words, software only is cool, but without an integrated approach with hardware, other software and a strong cultural base it just won't work... just look at the way industry giants have disappeared and the way they'll disappear in this decade...)

All of the above sounds really simple, nothing really new, and as you could say: 'OK, but where are the differential equations... this is easy...'; nevertheless it is not easy to actually deliver the goods... but no worries, we'll learn a lot of this in this class.

And then came the Sustainable GREEN PLM era... In a different industry, we can identify similar eager to develop new green products, processes, resources and service. As BMW's Dr. Burkhard Goeschel (CTO) states:

The BMW Group is the only major manufacturer of automobiles and motorcycles worldwide that concentrates entirely on premium products and outstanding quality for all its brands and across all relevant segments.

Like all other members of the automotive industry, the BMW Group operates in an area characterized by two contradictory developments. On the one hand, customer demands as well as requirements within the society, are constantly on the rise. On the other hand, competition within the industry is continuously shortening development times for new models even as cars become ever more complex products.

Therefore, developing and implementing innovations is the key element in the BMW Group's strategy to meet this twofold challenge and to maintain its position at the forefront of the automobile industry. Innovative products are clearly distinguishable from the competition, create desire and thus command a higher prize - with all three points being of vital importance in the premium segment. The company acknowledges only products and components that are clearly recognized as useful by our customers. In the same way, research activities are focused on so-called strategic innovation areas such as powertrain or driving dynamics in which the company seeks to maintain or achieve technological leadership.

Two areas that enjoy top R&D priority are Sustainable Mobility and Intelligent Mobility:

Sustainable Mobility
"To ensure the long term availability of adequate energy supplies, the BMW Group is committed to the principle of sustainable mobility, a concept that places emphasis on the efficient use of today's energy sources and the development of innovative solutions to meet future transportation needs. In order to reach this goal BMW Group further develops and enhances a variety of approaches, such as lightweight vehicle construction or the Valvetronic system which all help to decrease the consumption of carbon-based fuels.

The fuel of the future however, will be hydrogen. If generated with the use of regenerative energy sources, hydrogen is the only truly emission-free energy-carrier available. With the initiative BMW CleanEnergy the BMW Group strives to establish the hydrogen-powered internal combustion engine as the propulsion system of the future. Far from being a new player in this field BMW Group has started researching hydrogen technology 25 years ago. In 2004 the H2R prototype-vehicle set nine world records for hydrogen-powered cars, including a top speed of more than 300 km/h, thereby clearly showing the future potential of the hydrogen-powered internal combustion engine.

(In my view the fuel of the future is electricity... hybrid cars offer great transition, but the future is electric cars... hopefully with fusion, solar, wind and other methods we'll be able to produce clen electricity for all! The BIG challenge for humanity will be clean water, yes H2O, but that is another course...

Intelligent Mobility
Communication and information technologies give the automotive industry new opportunities for intelligent mobility in the future. BMW Group's ConnectedDrive networks telematics, online communication and driver assistance systems in order to enhance both safety and efficiency in transport. ConnectedDrive acts like a virtual co-driver presenting the right information at the right time, while still leaving the driver in total control. The active gas pedal, for example, "tells" the driver to slow down under specific conditions by exerting a greater counter-pressure against his foot. Intelligent route guidance taking even more detailed traffic information into account, helps to reduce road congestion and makes individual mobility more efficient in times of rapidly increasing vehicle numbers.

(Note, that whilst GM, Ford and Chrysler shrunk between 45 to 17%, BMW actually grew 17% in 2005-2006... guess why... quality made a BIG impact here too...)

More on **Green Engineering**: http://www.cimwareukandusa.com/All-Green/Ranky-GreenEngineering.html

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Now a few words about **Lean Product Development...** by Nancy Rouse-Talley. (She is a freelance writer who focuses on technology subjects, Desktop Engineering, December 2006)

'...Successful execution of a lean manufacturing program requires assessing processes, recognizing bottlenecks, and making improvements that not only eliminate holdups but improve efficiency. Simply automating existing processes is not the best way to implement product lifecycle management (PLM) programs. In fact, it might be a recipe for disaster because computerization could simply speed up unproductive processes without improving them, leading to an endless cycle of ineffective changes.

Software that manages design data, moves it to the factory, and promotes factory automation should be used once processes are streamlined and improved. Programs such as UGS Corporation's Teamcenter, PTC's Windchill, Agile Software Corporation's PLM products, Centric Software's Product Intelligence Software, and Dassault Systèmes' Enovia Virtual Product Lifecycle Management (VPLM), Smarteam, and MatrixOne make it easier to share complex engineering data across the enterprise. Digital manufacturing programs such as UGS' Tecnomatix and Dassault's Delmia, on the other hand, help manufacturing engineers validate production processes.
(Ranky: we use Dassault's Delmia, and other tools in this course...)

Companies that in the past were primarily concerned with lean manufacturing now also focus on lean product development. Lean methods have formed the foundation of Japanese automobile manufacturer Toyota's factory processes for more than 50 years, for example, but today the company also uses PLM to perpetuate lean product development processes.'...

For Whom is the Course Designed?

Graduate / Master of Science programs in Mechanical Engineering (ME), IE (Industrial Engineering), in EM (Engineering Management), in MnE (Manufacturing Systems Engineering) as well as an elective course for Graduate Mechanical Engineering, Graduate Computing Science, Industrial Design and Graduate Environmental Engineering, and Biomedical Engineering, Pharmaceutical, and other science and management students.

Note, that students with science background can take this course too. We follow a modular approach that makes the topic very adaptable to a variety of different environments. This approach has been successfully tested and run for several years at NJIT as well as on a consulting basis at large companies and software houses, such as Rolls-Royce, IBM, GM, Ford, Raytheon, and others.

Furthermore, the course is aimed at graduate research students, professional engineers and managers working in industry, wishing to learn about new, integrated design and manufacturing methods, **Sustainable GREEN PLM methods,** tools and technologies, and management methods, for the purpose of greening and improving products and services, and to learn how to innovate in a cost effective and productive way.

To summarize, the methods taught in this course are relevant not just to innovative product design, manufacture, test and quality control of products, but to a large variety of services too, because they reduce development costs, and improve working capital management, by offering powerful methods and software tools.

Note, that if you have taken the **IE673, Total Quality Management** course with me, you will find this course to be an integrated part of our advanced sustainable green and lean project management, total quality, decision analysis, and new product/process/service creation approach. In other words, nothing wasted, all integrated for the same great goals! IE655 is NOT the same course as IE673, although it looks initially similar!

Live as well as Distance and Hybrid (blended) Learning (eLearning) Students purchase their educationally priced, customized **eLearning Packs from the NJIT Bookstore (PLEASE ask for the current semester IE655 eLearning Pack. T**he pack changes every semester, therefore you need the current version. Both Live, as well as eLearning (DL) students get the same type of eLearning Pack from the bookstore). Every eLearning Pack is different, because it is customized, and this semester includes the following incredible resources:

- **The Main eTextbook of the course on a DVD, labelled 'B' for eBook.** Ranky: Concurrent / Simultaneous Engineering (Methods, Tools and Case Studies) with a **Sustainable GREEN PLM focus**, ISBN 1-872631-04-5. (Run this browser readable multimedia program by opening the a_StartCase.html file. It will support every topic we learn and every assignment in this class, and more...) ***You keep.***
- PLEASE note, that this browser readable, interactive multimedia eBook program / publication uses Apple's multi-platform

QuickTime program / plug-in for playing digital videos, as well as simulated 3D objects. Please make sure you have QuickTime installed (FREE from apple.com), as well as have your browser enabled to run QuickTime for ALL web sites. (As an example, in Apple's Safari browser, you have to open Safari 'Preferences', then click on 'Security', then select 'QuickTime' in the left hand side window, then click on 'Allow Always', and close the screen by clicking on 'Done'. Other browsers either have this feature integrated by default, or have to be set by the user in a similar way, else you'll see a link error when you are trying to play our simulated 3D objects.)

- **Four Collaborative Company Information Packs.** (***You keep.***) You'll need these, because you will have to collaborate with them in designing your new integrated PLM / CE product/ process in a collaborative/ concurrent engineering, digital design & digital manufacturing fashion, simulating virtual collaboration over the web. (Note, that company info is provided either in form of a printed document, and/or on a DVD, or CD-ROM, or as a URL, or as a mix of these media formats)
- **Also on a separate DVD, labelled 'V' for Videos: Industrial Case Videos** (the best on PLM)**; PLEASE NOTE,** that these videos are encoded using the latest and best quality MPEG4 codec by Apple and an International Consortium of professional companies. They play very well on any PC or Mac, the quality is in most cases as good as a standard definition DVD, or better, BUT the filesize is about 1/5th of the standard DVD MPEG2 file sizes we are used to... this is a HUGE advantage. Therefore, as long as you have a DVD player in the computer, and Apple's cross platfrom QuickTime it will play. You might need to download the latest version of Apple's QT (ver. 7, or later) FREE from: http://www.apple.com and then click on 'Downloads' at the top... (It is a dynamic web page, therefore if you look it up from a PC it will offer the Win compatible download, and from a Mac the Mac version; nice!) At the time of writing the MS Media Player cannot play this modern format. Also as far as I know, most TV-linked, standalone (i.e. not PC/Mac integrated) DVD players still cannot play MPEG4 files... BUT, due to the huge file-size reduction we can have all our videos on only a few DVDs, not 8-10 as in previous semesters... easier for you. **These are the full length Case Video files.**
- Note, that **the Ranky-Taguchi Design of Experiments files (in Beta) are in a folder within the CE eBook.** You'll use this together with the CORA method, as explained in the textbook as well as on the Component Oriented Requirements Analysis eBook. *if you find a bug in this spreadsheet program I will reward you with an **extra 10%** on the top of the achievable max. for the entire course! ...* **also includes the Ranky-Weibull Reliability Analysis files (in Beta).** You'll use this together with the PFRA method, as explained in the textbook as well as on the Disassembly Failure Risk Analysis eBook. ***You keep:** if you find a bug in this spreadsheet program I will reward you with an **extra 10%** on the top of the achievable max. for the entire course! **You keep all above as a valuabe resource!***

PLEASE note, that all above is for your personal educational non-profit use only, not to be put on the Internet or any servers, or make copies, else you might get into serious trouble with the USA copyright law... and as you know USA lawers are some of the best in teh world...

More important notes:

- Please note, that **each customized eLearning Pack is different**, nevertheless the methods we use are the same for every student. Each student should therefore use one eLearning Pack and work in collaboration with the companies offered. This is extremely important for you to learn about innovation, collaboration, globalization, networking, project management, and of course our core subject in this course, CE / PLM.
- Also note, that you will need a **multimedia PC** (approx. 900 MHz, with a DVD drive and 800x600 resolution screen min.; (as always in IT the faster the better...), a link to the Internet and email, as well as a recent version (not older than yr. 1998) of MS-Excel in your machine. (Note, that NJIT has thousands of these, and much faster computers if you need access to a computer.)
- To view the DVD videos you should have access to a computer with a **DVD player**. There are many of these systems at NJIT, as well as in public libraries in the USA, obviously you can use them too.
- PLEASE NOTE, that as a student of NJIT, you are entitled to **educational software and hardware discounts**, some free software, and site licenses, therefore make sure that you take advantage of the huge discounts and opportunities offered. (See the NJIT's bookstore, as well as contact NJIT's computing help desks and the NJIT website for further details).

More on USA Copyright Laws (as per NJIT's official statement):

The Higher Education Opportunity Act of 2008 requires that we inform the NJIT community of federal copyright laws and explain our policies and sanctions related to violation of copyright laws.

All members of the NJIT community are bound by U.S. Copyright Law when using NJIT computing resources. An important aspect of copyright law is the fair use doctrine which allows for limited reproduction of copyrighted works for various purposes such as criticism, comment, news reporting, teaching, scholarship, and research.

Copyright law does not permit the unauthorized distribution or sharing of copyrighted materials (e.g. music, movies, software, books, etc.) on computer networks. In particular, the illegal distribution of copyrighted materials via "peer to peer" file sharing techniques may subject users to criminal and civil penalties.

The Digital Millennium Copyright Act (DMCA), enacted in 1998, criminalizes distribution of technologies intended to circumvent measures that control access to copyrighted works. It also heightens penalties for copyright infringement on the Internet.

Copyright Infringement

Copyright infringement is the act of exercising, without permission or legal authority, one or more of the exclusive rights granted to the copyright owner under section 106 of the Copyright Act (Title 17 of the United States Code). These rights include the right to reproduce or distribute a copyrighted work. In the file-sharing context, downloading or uploading substantial parts of a copyrighted work without authority constitutes an infringement.

Current penalties for copyright infringement include civil and criminal penalties. In general, anyone found liable for civil copyright infringement may be ordered to pay either actual damages or "statutory" damages affixed at not less than $750 and not more than $30,000 per work infringed. For "willful" infringement, a court may award up to $150,000 per work infringed. A court can, in its discretion, also assess costs and attorney's fees. For details, see Title 17, United States Code, Sections 504 and 505.

Willful copyright infringement can also result in criminal penalties, including imprisonment of up to five years and fines of up to $250,000 per offense.

For more information, please see the Web site of the U.S. Copyright Office at www.copyright.gov, especially their FAQ's at www.copyright.gov/help/faq/.

NJIT Policies on Copyright

NJIT's Acceptable Use Policy for Cyber Resources requires all users to abide by copyright and trademark laws relating to the use of computing resources. Users shall not copy, disclose, modify, or transfer copyrighted materials. Exceptions are only granted under the fair use doctrine referenced above.

NJIT responds with haste to investigate all reported violations of copyright infringement through use of its computing resources. This includes reported violations of the Digital Millennium Copyright Act. Reported violations are investigated by the Telecommunications and Networks department in conjunction with the Dean of Students Office and/or the Office of Human Resources.

Violation of these policies may result in a range of sanctions beginning with loss of certain computing privileges up to suspension or expulsion from the university for students and termination of employment for employees.

Additional information on copyright infringement and the steps NJIT takes for combating the unauthorized distribution of copyrighted materials is available at http://ist.njit.edu/heoa2008/.

Legal Alternatives for Access to Copyrighted Music and Other Digital Materials

The Technology Support Center maintains a website with a discussion of copyright issues and sources for legal access to copyrighted movies and other digital content. Please visit: http://ist.njit.edu/music/music.php.

Reading for a degree... A few words about 'reading for a degree'... for hundreds of years, academics all over the world emphasized the importance of **reading for a degree**. Since we fully support this philosophy, in the eLearning Packs you'll find significantly more material than required for an 'A', to help even the most progressive students to learn more. Also, you are encouraged to use the Internet, and the NJIT Library. Here is a short list of excellent resources that will help you to deepen your understanding of the subject area of this course:

- Priest, J.W. and Sanches, J. M.: Product Development and Design for Manufacturing. A Collaborative Approach to Producibility and Reliability. Quality and Reliability Series, 2nd Ed., Marcel Dekker, Inc., ISBN 0-8247-9935-6, 434 p.,
- Boothroyd, G., Dewhurst, P., and Knight W.: Product design for Manufacture and Assembly, 2nd. Ed., Marcel Decker, Inc., ISBN 0-8247-0584-X, 698 p., and others.
- Morgan, J. M. and Liker, J. K.: The Toyota Product Development System. Integrating People, Process, and Technology, Productivity Press, New York, 2006, 377 p.

Academic Calendar

Please look up the accurate dates on the NJIT website.

Schedule: This semester is the equivalent of 15 weeks of study. You have to complete and submit 6 assignments (see them below in detail). There is no final examination, the course is assessed based on 6 assignments. (You might recall my motto: Happy Learning for REAL... assignments sound like real-world assignments versus examinations; and exactly what they are...)

The schedule and deadlines for all assignments are below. All assignments should be in electronic format. If there is something not clear, please email, or call, or make an appointment and see me (as specified above) during office hrs at NJIT.

Class 1 Introduction and overview of the course as well as the subject: Concurrent / Simultaneous Engineering (meaning exactly the same) and green sustainable PLM, in a traditional and in a modern design and manufacturing enterprise. Object-oriented (OO) and globally distributed enterprise models. Systems and integrated processes are explained. Our discussions are supported by DVD videos and virtual factory tours, and have an engineering management focus on how to find and reduce product design and process design related waste; on how to support integrated product / process design concepts and models, how to win over your competitors by following digital design & manufacturing principles and technologies, and how to innovate. Innovation is key in our 'Innovation Economy', in particular in the USA, competing with low labor cost nations on a global basis. If you learn about CE / PLM / Digital Design & Manufacturing, you basically learn how to secure your own job for a very long time!

Student Activities (this is what you should do to get an 'A' in this class, and most importantly learn the subject):

1. Please read this syllabus. Know your deadlines, what is needed, and by when. Deadlines are strict!
2. Review your eLearning Pack companies. Who are they? What are they doing? How can they help you with your new green product / process innovation? You must work with them... the boss says so...
3. Review all other resources in your eLearning Pack. See what you have and how do the resources relate to the study program in this class. There are CDs/DVDs supporting each assignment, and there is a book too. Look at them and see what they cover.
4. Watch all full length videos (in the 'V' marked DVD in the eLearn Pack). These videos will give you a good foundation.
5. Start to read the 3DeBook offered in the eLearning Pack. Most assignments are supported by Chapters in the main Concurrent Engineering 3DeBook. Look at it as a useful resource helping you with assignments and methods. View it electronically using the DVD inside the book; much nicer: all in color, with videos and active code...
6. To prepare for the first assignment start to view some of the videos (again). The more you can see at this stage the better. You should re-visit these videos later in the course to get a deeper understanding of the methods, principles and technologies demonstrated. They'll offer several new ideas and direction.
7. The first Assignment, labelled Assignment 0, since this is the zero stage, is to invent a new product/process with a **Sustainable GREEN PLM focus,** that you will develop (virtually) with the collaborative companies (the 4 companies in your eLearning Pack). Think of something that you are already familiar with, or have seen in the videos or in the eBook. As examples think of an existing design, that should be a green product, or customizing an automobile, or inventing a new walking, talking humanoid robot, or the hydroforming process (a great method to bend tubes, designers should know), or 4-axis turning using computer controlled CNC machine tools, or a smart hospital bed that is networked to the Internet, or a new cell phone (see an old model in 3D; a new toy, etc. You'll need Apple's crossplatform Quicktime player to play this! Whilst holding down the mouse move your cursor left and right to activate the 3D object; enjoy!) which has camera, email, web-access, music, video, a new smart humanoid robot that will iron your shirts, or clean the house, and the car, or a digital hub in your house for TV, vide, music, security, or telematics solutions for your car, or smart appliances in the kitchen, etc. There are plenty of opportunities! Just think and invent. Can think BIG, don't have to implement it all! I'll give you a lot of fredom to develop some of your ideas following the robust methods I am teaching you in this class; no worries, THINK BIG!

Class 2 Concurrent Engineering and PLM Methods, Tools and Technologies. The Product Development process. Focus on integrating design and manufacturing processes for the purpose of cutting waste, and improving quality. **Sustainable GREEN PLM** methods and tools for frontloading the product development process.

Submit: Assignment No. 0: Design your Own Concurrent Engineering, PLM, Digital Design and Digital Manufacturing System Design Challenge with the 4 Collaborative Companies in your eLearning Pack with a Sustainable GREEN PLM focus!

You can submit this assignment as an electronic document written in Word, or PDF, or even better in HTML and published on your own website. Note, that if you haven't got your web site up and running yet, at this stage I'll accept this document as an email attachement in Word. BUT, when you have your website working, I would like to ask you to post this as Assignment 0, with the rest of your assignments on the web site in HTML (not hyperlinked in Word! because HTML is Internet standard, MS Word is NOT...)

This work should be entitled: 'My PLM / Digital Design & Manufacturing challenge, my collaborative companies, and my plans for collaborating with them in order to develop, innovate and bring to market my new **Sustainable GREEN** product/ process design'.

Please address briefly all these issues using the following structure:

1. **Your full name** (as known to NJIT's Registrar, not nick names please) **and**
2. **Optionally your photo**
3. **Your eLearning Pack ID (this is a MUST!)**:
4. **Your virtual company name:** this is your company, the 5th company... like ABC Incorporated...
5. **The 4 collaborative companies**, their names and briefly what they are dealing with. (These companies are represented in your eLearning Packs and every one of these learning packs is different...) You should also explain how you plan to collaborate with them as you develop your new design.
6. **Please read the syllabus in detail.** There is a lot of useful information there too... also read eBook chapters 1, and 2, and see the videos too... also, very useful.
7. Now a bit more **about your company** (this is the 5th company): As you will see, although this is an educational experience, we'll play the game for real (within our virtual dream worlds...) because I would like you to become Chief Engineers and engineering management-focused CEOs helping to green the world... eventually... and many of you will... just work hard at it... it will happen! So, this is what I need from you, about 100-150 words on each topic as shown below:

    - **Your company's Strategic Plan - with a CE/PLM with a lean, green sustainable focus:** This is a plan that will give direction to your company, unite all employees and allow them to make decisions in context and with priorities that are consistent with your, i.e. the CEO's (Chief Executive Officer and Chief Engineer's) own vision. Employees must be given this because many employees have limited ability for forethought and planning. However, this plan must also be a collaborative work to get as much perspective from your team and have them understand what is behind the decisions.
    - At this stage only an approximate **Budget**(s) - Think of a startup company and try to estimate how much cash and resources you need to take off. Think of a 1 to 3 year plan. A simple and estimated budget should usually be broken down by department to insure accountability and authority for managers. This allows them to get things done and have the resources they need to grow their departments as necessary. It also sets them up to have the respect of their people and prevents major cash flow "surprises".
    - **To Be Trecked Metrics - with a CE/PLM and Green focus:** These are the metrics tracked over time in your company, that allow daily, weekly, quarterly and annual specific goals to be set and measured. Tracking, that has ratios (not just absolute numbers) are strongly recommended, but these are always specific to a particular company.
    - **Management By Objectives - with a CE/PLM and Green focus:** Your company needs a set of specific milestones and goals for monthly, quarterly and annual objectives. Without these there is no way everyone in the organization is pulling in the same direction and therefore lots of time and money will be wasted. Most executives and managers should be able to generate these and also review them with the team as monthly staff meetings to avoid communications issues. Good managers spend 50% of their time improving the business, not working in the day-to-day details. This is what creates competitive advantage and a rising company value and multiple.
    - **Key Processes - with a Sustainable GREEN PLM/ CE focus:** The key processes in your company must be agreed to as the business gets its value proposition and delivery down, especially when these processes are part of the core value and competitive advantage. These include your sales process, your R&D, your digital design and manufacture, PLM, etc. processes and your customer delivery process(es). These are often very ad hoc early on, but they must be more formalized as the business grows, as it's complexity increases and as customer legacy issues hinder forward progress. IMPORTANT here: **Conformance to eco-standards,** meaning: Does the product conform to national / international greenhouse emission standards? What is the carbon footpront of the product, process or service? How can this be reduced? Is this a sustainable lean and green product / process? You must convince me, I represent your venture capitalists / angels who will support your startup! More on **Green Engineering**: http://www.cimwareukandusa.com/All-Green/Ranky-GreenEngineering.html
    - There is one more thing I would like to ask you to do for explaining your company's (i.e. the 5th company's) **Sustainable Green** focus. Please go on the web, **Google YouTube, and then in the field at the top type in '*Paul Ranky*'** (this is a search field and you'll find it easily). It will show you over 120+ links to short video clips I put up on YouTube. The goal of this part of the assignment is for you to findany 6 short clips on Paul Ranky, YouTube that **deal with marine life**, (i.e. diving) and use those clips to convince your virtual board of directors and shareholders, that your 5th company MUST NOT POLLUTE the world, in ANY ways, ANY time... it MUST BE SUSTAINABLE AND GREEN; not just sustainable... but green too... these video clips show pristine marine eco-systems that must not be destroyed by greed, incompetence, or human error... Thanks; this will put your company on the map! Well done!To document this, please write a specific statement about your company, how you will prevent any toxic waste or pollution to be generated and released into any eco-system (land, sea, river, or air) in about **250 words**. **Please make sure you reference the 6 videos you have chosen from Paul Ranky, YouTube** by putting in their individual filenames, and/or with hyperlinks to YouTube if you have a web-page at this stage already for your assignment. (If you don't have a web-page yet, please add the hyperlinks to the Paul Ranky, YouTube dive video clips you have selected later, but definitely in Assignment 5.) Thanks!
    - **In order to get familiar with some really useful sustainable green methods and tools, please look up my article here: Ranky, P.G.: An Integrated Architecture, Methods and Some Tools for Enhancing Sustainable Enterprises**

and Systems
Article Published in Systems 2015, 3(2), 27-44; doi:10.3390/systems3020027; Received: 9 February 2015 / Revised: 14 April 2015 / Accepted: 24 April 2015 / Published: 4 May 2015; Show/Hide Abstract and Link to Full Article (FREE access) http://www.mdpi.com/2079-8954/3/2/27

- **Last, but not least do not forget your social networking content at the end of this assignment, as part of it.** During the semester, I will email you several links to short technical articles, that are really important for you to follow and understand what is going on in the world in our subject area. This is particularly important to some foreign students who are not used to get their news via the Internet. You suppose to chose three of these articles (for every assignment, including this one, as well as the Midterm) and then discuss at least THREE (3) of them with at least one more member in your class, and then document your findings in your social networking part of EACH assignment. I would like to see that you are discussing the content of these articles. Usually in a semester I send out about 20-25 short and current articles to chose from. Through my editorial work with major journals I get hundreds of *just published* articles that I can choose from... I am looking for your executive summaries of the discussions you have documented with one or more of your classmates via tel., email, in-person, and/or video conferencing. These activities are all part of each assignment now and therefore should be documented in your web page as an executive summary, just as the rest of your assignments are. The detailed discussions of these articles could be saved on Moodle, or anywhere else (your choice), in a digital format. Your executive summaty in your assignment should hyperlink to the detailed discussions (where ever you have stored them). All in one; nice object-oriented principle; not zillions of separate files please!

Note, that according to Bob Norton, *CEO: ...if you have these five systems in place and operating well, in the REAL world, you are prepared to scale your business at 100%, 200% or even more rapid growth. Without these it is likely you will have many problems growing. The hidden costs of this will make you uncompetitive and cost you market share, customers and first mover advantages. Bob also suggests, that there are these five things that need to be in place for a company to move into high growth mode without betting the company and without all kinds of problems arising... These things come from experience and the best practices developed over a century of 'good' management. They are proven, not "management of the month club" fads that come and go.*

Would you want a newly graduated doctor to do brain surgery on you or your family? Not likely! This is because you recognize the difference between education and experience, between theory and real practice and wisdom. You recognize the difference between reading about flying and actually flying a plane! Who would try to fly a plane alone after just reading a few books on flying!? So how come most CEOs who have not run a larger high growth business think they can do it alone and reinvent all the needed systems and best practices themselves on the fly!? Well, most likely because we CEOs must have extreme confidence (often viewed as arrogance by others) to even try to start a company. We are risk takers and willing to tackle large problems with our intellect, however, we must get experience, guidance and input from others who have "been there and done that" to avoid many pitfalls that can kill a company, or stop its growth completely...

Most early-stage companies have the first major growth problems at a level of about 15-25 employees and between $1million and $2million in revenue. This is the zone in which it is critical to begin to transition from raw entrepreneurship to professional management practices. Many CEOs and founders have not had the high growth experience at this Stage 3 to Stage 4 development phase and inevitably major problems will occur. It is easy for the "wheels to fall off the wagon" as you accelerate the business. Small percentage growth of 10% to 30% can require significant changes as it becomes very significant absolute growth. Usually at this point the CEO can not keep track of everything and needs to depend more on the management team. This means you need systems and procedures that keep the owners and CEO comfortable, and also give management and others room to grow their responsibilities...

... and this is exactly what we'll be learning about in this course with a strong engineering management focus... Now back to reality...our course: Note, that just as in the real world, you can change the focus of your project(s) later as you develop them, but you'll need my approval to go ahead. This is why I need the single page executive summary emailed to me. (This is also a good time to start to set up your web page...)

I will respond to this by email, comment and hopefully accept your plans. When you have your web page up and running, include this Assignment 0 to have a nice, integrated documentation approach to all of your assignments on the web.

Don't miss the fact, that this is a Concurrent Engineering, PLM and NPI&I - focused class! Make sure, that your assignments reflect this! Also, you must collaborate with the 4 companies in your eLearning Pack!

Again, this is the way the **rework of assignments** works: you submit your assignment on deadline (or before) and within a few days I'll grade it and email you the grade with comments. Then you can start to improve the assignment based on my comments. After this do not resubmit it, only at the end of semester when all assignments are to be reworked and resubmitted anyway. Then I can reward you (hopefully) for all improvements you have made during the semester on all your assignments. The web page control is in YOUR hands, therefore you work on it when you can, as many times as you can. All I need is deadlines to be kept! Fair and mimics real world action.

Classes 3, and 4 Concurrent Engineering, PLM and NPI&I (New Product Innovation & Introduction) in our rapidly growing research and development world = DVD Video Lectures and high quality case study videos. Enjoy; you are seeing and experiencing the past and the future...

Submit: Assignment No.1: Concurrent Engineering Video Lectures and 3DeBook reading / study. (Relevant eLearning Pack Resource: work through the DVD videos and eBook chapters). Take notes as you watch the videos. You'll need these notes in some of the other assignments too!

1. In terms of assignment documentation method, please follow the Documentation section of the 3D eBook in your eLearning Pack.
2. Title, Author (Name, Class, Date, your eLearning Pack ID number, and the 4 collab. companies you have (a MUST!)
3. Statement on who has done the work, even if done in a team: **EACH individual, and this is true for all assignments, must submit an assignment by himself/ herself!**
4. Contents
5. Introduction and Objectives of the Project
6. A brief description of the methodologies applied.
7. **The Main Body of the project:**
    1. **View and study the CE / PLM Lecture and Software Demo Videos (in the DVD)**
    2. **Show me, that you have seen and understood the** a **Sustainable GREEN CE/PLM focus in these videos, by answering your own 5 questions for each video.** *(Answer your own questions with about 3-4 sentences each.)*
    3. **Based on the 3DeBook in the DVD, a**nswer the following questions:
        1. What is CE and PLM?
        2. What is the difference between CE and PLM?
        3. What is green sustainable PLM?
        4. What is digital design & manufacture and why is this such a huge opportunity?
        5. How is digital design integrated with digital manufacturing in PLM?
        6. What is frontloading, and why is it critical to understand this process?
        7. **Read Chapters 1, 2 and 3** of the 3DeBook. Find 5 questions in EACH of these Chapters and answer them. Each answer should be min. 3-4 sentences long, but it's really up to you if you want to write more... and even add figures, photos, etc. You are free to explore.
        8. **Last, but not least do not forget your social networking content.** (This is an executive summary, with a hyperlink to the rest of the material you have documented, based on discussions with your classmates on articles I have sent you by email, all on your web site, NOT in a separate file attached to an email! This part of the assignment reflects your active participation in the class based on discussions of the articles I am emailing you every week...)
8. Summary (i.e. what has been achieved)
9. Further work needed / proposed
10. References and Bibliography (including the CDs, Internet as a main source of information)
11. Appendix (- if necessary)

Typical Mistakes: Why am I loosing grade points in this assignment?

- The assignment's administrative section is missing, and/or is incomplete...
- The above outline is NOT followed
- Only a few videos are discussed ... several questions and answeres are missing... the questions created are not relevant, miss the focus...
- The answers are copied from the eBook or from each other; Sorry, you must innovate and create your OWN questions and answers.

Classes 5 and 6

QFD (Quality Function Deployment); Component-oriented Requirements Analysis is discussed with 3D Virtual Reality examples as an OO Concurrent Engineering / PLM methodology. Note, that we are dealing with the "Product Planning Stage QFD diagram/ matrix. i.e. the very first one.

Student Activities:

1. Carry on reading the 3DeBook offered in the eLearning Pack.
2. Watch the videos again with a customer requirements analysis focus: What customer requirements / needs are these products / processes satisfy?
3. **Based on CORA:** The CORA chapter in the eBook educates a requirements analysis method and offers examples and solutions, as well as active code-tools for you to execute (in the form of MS Excel templates). You should understand this and

based on the MS-Excel Template, develop your own Requirements Analysis solution for the product you are developing, with the 4 collaborative companies. As outlined in Assignment 0). The example given is a detailed study. Try to fully understand it because it is very important.
4. Study the QFD / Requirements Analysis method and the 3D objects. Consider the requirements analysis aspects when designing your new product.

Class 7

QFD (Quality Function Deployment) / Requirements analysis is discussed with 3D Virtual Reality examples as a Concurrent Engineering methodology. Focus on the Assignment this week! We like professional quality assignments!

Submit: Assignment No. 2: QFD1 / CORA (Quality Function Deployment; Component Oriented Requirements / Needs Analysis). In terms of assignment development method, please follow the CORA CD-ROM in your Learning Pack. **(Relevant eLearning Pack Resource: Requirements analysis chapter in the 3DeBook)**

When developing the QFD1 matrix for a product try to put down all customer requirements for the WHAT's side, prioritize them, then create the HOW's, this is the "engineers' voice", then the HOW MUCH's, which will give you the parameter ranges for satisfactory data and then develop the rest of the correlation and the comparative quality models on the right hand side of the matrix. The crucial thing is that in the report you should explain what you have done and why?

Please note, that the best assignments show evidence that the student has worked through the learning material provided in the 3D eBook. Therefore feel free to incorporate digital images, text and even video clips or 3D VR objects provided into your assignment; nevertheless never forget to credit the source of such objects in the bibliography.

Assignment No. 2: QFD1 /CORA (Quality Function Deployment; Component Oriented Requirements / Needs Analysis)

1. In terms of assignment documentation method, please follow the Appendix of the CORA 3D eBook in your Learning Pack.
2. Title, Author (Name, Class, Date, your eLearning Pack serial number, and the 4 collab. companies you have (a MUST!)
3. Statement on who has done the work **EACH individual, and this is true for all assignments, must submit an assignment by himself/ herself!**
4. Contents
5. Introduction and Objectives of the Project
6. A brief description of the methodologies applied.
7. **The Main Body of the project:**
    1. Read Chapter Six in the 3D eBook: Review and explain in a few sentences each image what the the customer requirements were / could have been based on the images offered (image files: IMG_1122 to IMG_1174 section).
    2. Based on Chapters 7 and 8, develop your own CORA product requirements model using the CORA Excel Template. Focus on creating a sustainable green design!
    3. Show your main requirements, and solution processes in this spreadsheet, that you have to customize, based on the CORA Template spreadsheet.
    4. In this assignment, also use our Beta ver. Ranky-Taguchi calculator (**in the same DVD in a separate directory**) for designing an experiment for a given case. Read the Word file first, then study the spreadsheet examples, then study the CORA requirements analysis method, and finally calculate at least one of the parameters you need in the CORA spreadsheet using the Ranky-Taguchi calculator. Look for bugs! If you find one I'll give you extra 10% for the entire course! Also, note, that Fanny is French, therefore the English writeup needs more work... it is still in beta, but will be very good soon...The maths is already very good.
    5. When you finish your CORA spreadsheet calculations, make sure you analyze and explain the results:
        1. What is your analysis of the calciulated results, and what are your decisions based on the CORA analysis, and why?
        2. Show me, that you understand what you should do and why... all based on the CORA spreadsheet.
        3. Also find the top three largest AIR numbers in the CORA matrix and explain what are you going to do with the findings? This analysis of the results is critical! I would like to see that you understand the results of CORA and then you can manage your design team, based on the results! Many students miss this, don't be one of those!
        4. Also explain to me how the design specification gained from CORA integrates with the manufacturing plans. (This product and process / manufacturing / assembly process integration is crucial to achieve full green PLM!)
    6. Also show how your (real, or made up, i.e. the 5th) company can collaborate in designing new hardware/ software / service with a **Sustainable GREEN PLM focus** with the collaborative companies. (There are 4 companies you have to collaborate with; explain HOW you are planning to do this together with THEM. YOU MUST WORK WITH THEM; sorry; the boss says so...).
    7. **Last, but not least do not forget your social networking content** (as above).
8. Summary (i.e. what has been achieved)
9. Further work needed / proposed

10. References and Bibliography (including the CDs, Internet as a main source of information)
11. Appendix (if necessary)

Typical Mistakes: Why am I loosing grade points in this assignment?

- The assignment's administrative section is missing, and/or incomplete...
- The above outline is NOT followed
- The models / solutions are copied from the samples offered; Sorry, you must innovate and create your OWN designs, and models.
- The analysis of the CORA results is thin, or missing, or not explained. You must explain what you plan to do with teh CORA results and why.
- The sustainable green focus is missing.
- The collaborative companies are not included properly. Sorry, you MUST collaborate!
- The CORA model is incomplete, or inaccurate. Decisions are not explained.
- The Ranky-Taguchi DOE calculator is not being used, or the results are not explained accurately.

Class 8

FMEA: The Failure Mode and Effect Analysis, or Process Failure Risk Analysis / Disassembly Process Failure Risk Analysis methodology and its use in CE.

You are developing this for a product / process, or service for your company with a CE/PLM focus! In order to complete this assignment you must read **Chapter 9 in the 3DeBook**.

Relevant eLearning Pack Resource: Study the DFRA Case Study! Note, that the DFRA method is focusing on using the FMEA method for disassembly process failure risk analysis. This eBook educates a the method and offers examples and solutions, as well as active code-tools for you to execute (in the form of MS Excel templates). Learn this method, as well as read the book chapter on FMEA, and then based on the MS-Excel Template develop process/ design (potential) failure modes of YOUR product, that you are designing. Please make up missing data.

Class 9

Design For Manufacturing, Quality, Assembly, KANRI, KAISEN, MUDA, MURA, MURI, POKA-YOKE, the role of Quality Circles, and other methods discussed with 3D Virtual Reality examples. (Part 1).

Submit: Assignment No. 3: Process Failure Mode and Effects / Failure Risk Analysis: Risk-based Design, in the CE Context

The student's main task is to pay attention to the multimedia presentations, to take notes on every important issue, item, principle, and example, to interact with the tutor (on Email, Fax, Telephone, etc.) and the class members (on Email, Fax, Telephone, etc.) and fully understand the topics covered.

Student Activities and relevant eLearning Pack Resources

1. Carry on reading the eBook / textbook offered in the eLearning Pack.
2. The videos illustrate several risky processes.
3. The DFRA chapter in the CE eBook takes you through the entire process.
4. Then analyze each important failure mode. In case you choose to deal with a larger system, such as an automobile, or tank, etc. deal with larger objects only in the BOM /DBOM file, else you'll spend your life on it... Nevertheless the "trick" is to find the critical subsystems that might fail, and then find out why they might fail?

Please keep this in mind: I am interested in seeing that you understand the methods... I don't want you to spend your entire life on these assignments... you follow...Please note, that the best assignments show evidence that the student has worked through the learning material provided on DVD-ROMs and in the book. Therefore feel free to incorporate digital images, text and even video clips or 3D VR objects provided into your assignments; nevertheless never forget to credit the source of such objects in the bibliography.

Project/ Assignment No. 3: Process Failure Mode and Effects / Failure Risk Analysis in the CE Context

1. In terms of assignment documentation method, please follow the Appendix of the eBook in your Learning Pack.
2. Title, Author (Name, Class, Date, your eLearning Pack ID/serial number, and the 4 collab. companies you have (a MUST!)
3. Statement on who has done the work **EACH individual, and this is true for all assignments, must submit an assignment by himself/ herself!**

4. Contents
5. Introduction and Objectives of the Project
6. A brief description of the methodologies applied.
7. **The Main Body of the project:**
    1. Develop your FMEA/ DFRA (the same) model using the 3D eBook Excel Template, for the product, that you are developing, in a collaborative fashion with your eLearning Pack companies.
    2. Show your main process failure modes, and solution processes in this spreadsheet, that you have to customize, based on the DFRA Template spreadsheet. Note: if a product / process fails it is not sustainable! Please make sure to include at least 12 process steps in the FMEA / DFRA spreadsheet at the left hand side of the preadsheet where the mainrisky process steps are listed.
    3. Explain in detail what your engineering management decisions will be based on the calculated results in the PFRA spreadsheet. This is VERY important!
    4. In Chapter 4 in the CE 3DeBook, review image set IMG_1684 to IMG_1704 and describe potential failure modes. It is a product you probably have never seen, therefore this should be an interesting challenge! I am expecting you to write about 1 page on this analysis.
    5. In this assignment, we also use our Beta ver. Ranky-Weibull calculator (also in the eBook ***DVD***) for considering the reliability analysis for a given case (samples in the CD). Read the Word file first, then study the spreadsheet examples, then study the DFRA risk analysis method, and finally try to calculate reliability rel;ated risk with the Ranky-Weibull spreadsheet, and then integrate your findings with the rule-based approach in the DFRA spreadsheet. Interesting research task; have fun! The rule-based method is great, but if we can have data we can calculate with the Weibull maths. Show how this could be done using our templates. This is the new research in this exercise. Also, look for bugs in the Ranky-Weibull spreadshheet! If you find one I'll give you extra 10% for the entire course! Also, note, that Fanny is French, therefore the English writeup needs more work... it is beta, but will be very good soon... The maths is good though.
    6. Also, show how your (real or made up) company can collaborate with the companies given you in your Learning Pack (there are 4 companies you have to collaborate with; to avoid process failures. Explain HOW you are planning to do this together with THEM. YOU MUST WORK WITH THEM; sorry; the boss says so...).
    7. Make sure, that in all cases you explain the resuts clearly. I want to see, that you understand what you should be doing with the FMEA / DFRA spreadsheet results you just created. This is a core engineering management aspect of this assignment.
    8. **Last, but not least do not forget your social networking content at the end of this assignment, as part of it** (as above).
8. Summary (i.e. what has been achieved)
9. Further work needed/proposed
10. References and Bibliography (including the CDs, Internet as a main source of information)
11. Appendix (if necessary)

Typical Mistakes: Why am I loosing grade points in this assignment?

- The assignment's administrative section is missing, and/or incomplete...
- The above outline is NOT followed
- The models / solutions are copied from the samples offered; Sorry, you must innovate and create your OWN designs, and models.
- The analysis of the calculated results is thin, or missing.
- The collaborative companies are not included properly. Sorry, you MUST collaborate!
- The PFRA/DFRA model is incomplete, and/or inaccurate.
- The Ranky-Weibull method / calculator is not used.

Class 10

Design For Manufacturing, Design For Green Sustainable Manufacturing, Quality, Assembly, KANRI, KAISEN, MUDA, MURA, MURI, POKA-YOKE, the role of Quality Circles, and other methods discussed with 3D Virtual Reality examples and classroom exercises. Rapid prototyping methods and solutions (Part 2).

Focus on the engineering related challenges/ questions, but most importantly on lean, sustainable green design. Try to answer 10 selected questions of your choice! Incorporate these answers into the Assignment below!

Class 11

Design for Demanufacturing, disassembly, Virtual Product Disassembly over the web, and other methods discussed with 3D Virtual Reality examples and classroom exercises. Rapid prototyping methods and solutions. Networked Concurrent Engineering systems in digital collaborative factories. Discussion on network modeling methods and tools. PLM (Product Lifecycle Management), NPI & I

(New Product Innovation and Introduction).

Student Activities:

1. Carry on reading the book offered in the eLearning Pack.
2. **Based on the Rapid Prototyping eBook:** Focus on the engineering related challenges/ questions in this eBook.
3. Try to answer 10 selected questions of your choice! Incorporate these answers into the Assignment below!

Submit: Assignment No. 4: Sustainable Green Design for Manufacturing / Assembly / Environment Methods and Technologies Study

The students' main task is to pay attention to the multimedia presentations, to take notes on every important issue, item, principle, and example, to interact with the tutor (on Email, Fax, Telephone, etc.) and the class members (on Email, Fax, Telephone, etc.) and fully understand the topics covered.

Project/ Assignment No.4: Sustainable Green Design for Manufacturing / Assembly / Environment Methods and Technologies Study

1. In terms of assignment documentation method, please follow the Appendix of the eBook in your Learning Pack.
2. Title, Author (Name, Class, Date, your eLearning Pack serial number, and the 4 collab. companies you have (a MUST!)
3. Statement on who has done the work **EACH individual, and this is true for all assignments, must submit an assignment by himself/ herself!**
4. Contents
5. Introduction and Objectives of the Project
6. A brief description of the methodologies applied.
7. **The Main Body of the project:**
    1. Develop/ select/ identify your own company's Sustainable Green Design for Manufacturing / Assembly / Environment Methods and Technologies methods / model/ strategy using the list of methods offered in the 3D multimedia eBook in your eLearning Pack,
    2. Also, incorporate other green design and green manufacturing methods and tools you can find on the web, for the product that you are developing, in a collaborative fashion with the 4 companies you have to work with...
    3. Answer any selected 10 questions in **Chapter 3** of the eBook, by writing approximately 3-4 sentences on each with some optional sketches if necessary. Address Design For Green, Manufacturing, Quality, Assembly, KANRI, KAISEN, MUDA, MURA, MURI, POKA-YOKE, the role of Quality Circles, Design for Demanufacturing, disassembly, Virtual Product Disassembly processes / methods.
    4. Furthermore, research OTHER sustainable green product design, green PLM methods on the web. Explain the methods, principles, and main application areas in your assignment.
    5. Also, show how your (real or made up) company can collaborate globally in a CE / PLM environment, with the companies given you in your eLearning Pack (there are 4 companies you have to collaborate with; explain HOW you are planning to do this together with THEM. YOU MUST WORK WITH THEM; sorry; the boss says so...).
    6. **Last, but not least do not forget your social networking content.** (as above)
8. Summary (i.e. what has been achieved)
9. Further work needed/proposed
10. References and Bibliography (including the CDs, Internet as a main source of information)
11. Appendix (if necessary)

Typical Mistakes: Why am I loosing grade points in this assignment?

- The assignment's administrative section is missing, and/or incomplete...
- The above outline is NOT followed
- The models / solutions are copied from the samples offered; Sorry, you must innovate and create your OWN designs, and models.
- The collaborative companies are not included properly. Sorry, you MUST collaborate!
- The green PLM model /strategy is incomplete. Did not address Design For Green, Manufacturing, Quality, Assembly, KANRI, KAISEN, MUDA, MURA, MURI, POKA-YOKE, the role of Quality Circles, Design for Demanufacturing, disassembly, Virtual Product Disassembly processes / methods.

Class 12 and 13 (Don't worry, it's almost over...)

Concurrent Engineering / PLM Team management methods and issues. The TOPS method (The Ford Motor Company). Virtual teaming methods over the Internet. A 3D Virtual Reality web-based method and code is discussed in detail.

Student Activities:

1. Carry on reading the book offered in the eLearning Pack.
2. **Based on the eBook:** study collaborative teamwork opportunities. (This section links from the documentation methods chapter and has a series of important principles, that you can work with).
3. **Search for New Sustainable Green Product Innovation and Introduction** (NPI & I) methods, tools and technologies over the Internet. Try to collect at least 10 URLs with a short explanation of the method they cover.

Class 14 and 15 (Note, that Classes 14 and 15 are kept for Assignment related project improvements)

Submit: Assignment No. 5: Concurrent Engineering Product Design Review / Assessment and Improvements: New Product Innovation & Introduction (NPI & I) Challenges

-> Part 1: Innovative PLM Design, and

-> Part 2: PLM / Green and Sustainable Digital Design & Digital Manufacturing Transition Plan, Marketing Plan (Press Release of your new product/ process/ service)

Documentation Structure for Assignment #5

1. Author (Name, Class, Date, your eLearning Pack serial number, and the 4 collab. companies you have (a MUST!)
2. Statement on who has done the work.
3. Contents: List the main topics in this Assignment
4. **Part 0 of this assignment is to resubmit all reworked assignments** with detailed explanations on what did you improve based on my comments. Note, that statements, such as: 'based on the professors comments I have improved Assignment i, please find it linked here...' are not acceptable, since you haven't specified exactly what my comments were and what you did to improve your assignment. The reworked assignments must be hyperlinked here with a single URL link for each assignment you have reworked, so that I can find them easily. Please note, that at this stage of the course I have a lot to grade, therefore if you don't follow my instructions and structure, send me several emails with several files, still have no webpage (!!!) I might miss some of your valuable work... so, please help me, so that I can help you. As I go through your reworked assignments, I'll change the grade if you deserve it and then I'll add this to the total number of points you have earned in this semester in this class. Then, I start to grade your Assignment 5. This is my process and it is more than fair, since most profs. do not allow reworks...
5. **Part 1: 10% of 30%: Innovative Green PLM Design: The Main Body of the assignment:** Now that you have understood our green CE/PLM approach, focus on finding an existing non-sustainable green design and then changing that design to a new sustainable green product of your choice, like a new toy, automobile, machine, or... cell phone (perhaps based on an old design that everybody understands well). Please note, that copy-paste jobs from the Internet will not be accepted! You have to come up with novel ideas!
6. Discuss the product/process innovation and introduction methods and process you would suggest your company to follow, based on what we have learned, based on your projects in this course, and the collaborative companies in your eLearning Pack. You can use any resources, including what we have learned, the library, the web, your company, anything legal...
7. **Search for New GREEN Product Innovation and Introduction** (NPI & I) methods, tools and technologies over the Internet. Try to collect at least 10 URLs with a short explanation of the method they cover.
8. Document your thoughts, methods, models, strategies and technologies that you plan to use in your future work. This essay should cover the above with a CORA requirements model for a new product, such as a **new** toy design, or cell phone, a design-oriented Failure Risk Analysis model for the **new** toy design, or cell phone and some explanations on the rapid proto. method/technology one should choose to prototype it. Include all aspects that you can address, i.e. hardware, industrial design, software, service and networking, functionalities, etc. Offer text explanations, plus figures, images, and digital media, as necessary to present your new cellphone design to a (virtual board of directors, i.e. the class and myself, over the web) for venture capital support (sorry, again all on a virtual basis only...).
9. Further work needed / proposed: What other methods could be integrated and HOW? How could you make your new product design to be that of a successful product in the marketplace? (We want to see you how you can innovate, and succeed using the learned and other methods!
10. **Part 2: 10% of 30%: PLM / Digital Design & Digital Manufacturing and Sustainable Green Transition Plan for a company of your choice: The Main Body of the assignment:** Now that you understand CE, PLM / Digital Design & Manufacturing, convert your company into a PLM Consulting Company, that specializes in turning traditional engineering businesses into modern, PLM/ Digital Design & Manufacturing companies. Create a true engineering management solution, covering the following:
    1. A **convincing lean and sustainable green design marketing plan** for the CEO / CTO that they should move into PLM / Digital Design & Manufacturing. Keep in mind, that many of them will raise the typical arguments, until it is too late not to go under: Our current systems are OK, no need to change... Green PLM is far above our budgets... We are already doing this, no need to change... We cannot change our CAD systems because all the files are in a different format and we'll loose everything we have designed during the past 10 years... Nobody wants to change our systems... Takes ages to learn a new PLM system, we haven't got the time and money to do this... We are not operating on a global basis, we

don't need it... and others. You should advocate the innovation opportunities using a library of reusable objects. Develop your arguments in this direction... This is key for all of us to survive. (One of Toyota's key secret is that they create well designed and tested platforms populated with reusable objects / modules. For each new release they carefully and gradually adjust these reusable objects and change them as the market demands this change. They also test everything in the digital domain first, and develop everything in integration with manufacturing, assembly, quality control, maintenance, etc. in mind... In comparison, the traditional product design company would start from scratch with everything for each product release. As a result, whilst they release on new product at high cost and with mistakes, Toyota will release 3 or more with well tested reusable objects... Now you know!)
2. A **transition strategy and process plan (use the ISO standard CIMpgr process modeling method).** You can assume, that the company already uses CAD / CAM, but most of it is a mix of 2D and 3D tools, and they are not integrated into a PLM level we saw in the DVDs in this course. (This plan should also include a PLM education plan: How would you educate PLM to the average small, medium and large size businesses?)
3. Create an implementation and test plan
4. Design a ROI plan (a simple plan will do at tghis stage) - make up all missing data.

11. **Part 3: 10% of 30%: Conduct a Video Conferencing and Social Networking session. Do not forget your social networking content.** (This is an executive summary, with a hyperlink to the rest of the material you have documented, based on discussions with your classmates on articles I have sent you by email, all on your web site, NOT in a separate file attached to an email! This part of the assignment reflects your active participation in the class based on discussions of the articles I am emailing you every week...) **For VC use SKYPE, or whatever software you wish to use** (free over the web) VC with one of your classmates and discuss each others' designs. Try to create a collaborative sustainable green product design review team spirit and document your findings... This is what you should document professionally (pls. note, that if you don't document it as below I won't be able to five you teh extra grade points; sorry):
12.
    1. The purpose of the video-conferencing session is to conduct a virtual product design review? What is a product design review? How did you prepare your files for this web-based VC product design review?
    2. What were the most important steps in your product design review process?
    3. What software did you use for VC and how? (Must include 3-4 screen prints of the VC session as a proof.)
    4. What did you discuss and achieve during the VC session? (Offer a script of your discussions in professional English, not in *'hej dude whatsup'* language...)
    5. How do you like this video-conferencing approach for collaborative CE/PLM problem solving?
    6. What were the main challenges?
    7. What worked well, and what did not, and why?
    8. In comparison to a face-to-face visit, versus VC, what is the estimated carbon footprint saving to the environment? How did you calculate this result? (Hint: search the web, there are some really useful carbon footprint calculators for free!)
    9. What are **Green Engineering** benefits of using VC? More on **Green Engineering**: http://www.cimwareukandusa.com/All-Green/Ranky-GreenEngineering.html
13. **SOCIAL NETWORKING:**During the semester, I will email you several links to short technical articles, that are really important for you to follow and understand what is going on in the world in our subject area. This is particularly important to some foreign students who are not used to get their news via the Internet. You suppose to chose three of these articles (for every assignment, including this one, as well as the Midterm) and then discuss at least THREE (3) of them with at least one more member in your class, and then document your findings in your social networking part of EACH assignment. I would like to see that you are discussing the content of these articles. Usually in a semester I send out about 20-25 short and current articles to chose from. Through my editorial work with major journals I get hundreds of *just published* articles that I can choose from... I am looking for your executive summaries of the discussions you have documented with one or more of your classmates via tel., email, in-person, and/or video conferencing. These activities are all part of each assignment now and therefore should be documented in your web page as an executive summary, just as the rest of your assignments are. The detailed discussions of these articles could be saved on Moodle, or anywhere else (your choice), in a digital format. Your executive summaty in your assignment should hyperlink to the detailed discussions (where ever you have stored them). All in one; nice object-oriented principle; not zillions of separate files please!
14. References and Bibliography (Including books, articles, the Internet as a source of information, DVD-ROMs and the serial numbers you have used
15. Appendix (if necessary).
16. I need your FULL documentation electronically (preferred on the web as a URL, linking to your web-friendly files) **All submissions MUST be electronic = by email / with a web URL in it; NOT several separate files please; I cannot accept several separate files, sorry, this is the 21st Century... we live in a digital age... Please note, that the absolute last day to submit any assignment is December 11, 2019. Sorry, no delays are accepted!**

17.
18. **Schedule and due dates:** As above. The total course duration is 15 weeks. Students will be required to complete each assignment. Grade "A" for this class requires min. 90% total. I want to give you an 'A', BUT YOU must do the work at a high quality. Thank you for helping me to be able to help you! Your success is my success too!
19. One more time, the NJIT Grade Scale:

    90-100 = A
    85-89 = B+
    80-84 = B
    75-79 = C+
    70-74 = C
    60-69 = D
    0-59 = F

Feedback to the Anonymous Total Quality Feedback Form: IE655 (January 21, 2003)

Please rate the following topics planned to be covered in this class by rating each topic between 0 (not important / poor) and 10 (extremely important / excellent!) on the right hand side of the sheet please!

This feedback form will help your instructor to dynamically adjust the breath and the depth of the topics to be covered in this semester in this class to maximize your level of quality satisfaction.

Topics (as per the web-based syllabus) Your rating (0 -> 10)

Web-based syllabus (Rated: Very High)

eLearning Pack (Most students haven't seen it yet)

Introduction and overview of the course as well as the subject: Concurrent / Simultaneous Engineering (meaning exactly the same) in a traditional and in a modern design and manufacturing enterprise (Rated: Very High).

Object oriented (OO) process and enterprise models are introduced (Rated: High).

Systems and integrated processes are explained using traditional as well as new, OO methods (Rated: High)

Engineering management focus on how to find and reduce waste; how to support integrated product / process design concepts and models. (Rated: Very High)

Concurrent Engineering Methods, Tools and Technologies (Rated: Very High)

Process modeling the digital enterprise (Rated: Very High), with the exception of one: rated very low (2))

Focus on integrating design and manufacturing processes for the purpose of cutting waste, and improving quality (Rated: Very High)

Process modeling methods and examples (Rated: Very High)

Object Oriented Concurrent Engineering Information System Models (CIMpgr, Object Oriented Process Modeling is explained and discussed through exercises and examples) (Rated: Very High, with the exception of one, rated low (3))

QFD (Quality Function Deployment) (Rated: High)

Requirements Analysis is discussed with 3D Virtual Reality examples as an OO Concurrent Engineering methodology (Rated: Very High)

FMEA: The Failure Mode and Effect Analysis, or Process Failure Risk Analysis methodology and its use in CE (Rated: Very High, two rated it Medium)

Interactive FMEA modeling / Disassembly Failure Risk Analysis modeling with the 3D Virtual Reality examples on the DFRA CD-ROM (Rated: Very High)

Design For Manufacturing, Quality, Assembly (Rated: High)

KANRI, KAISEN, MUDA, MURA, MURI, POKA-YOKE (Rated: High, some did not know what this meant, so we are going to discuss it in detail)

The role of Quality Circles, and other methods discussed with 3D Virtual Reality examples and classroom exercises (Rated: High)

Rapid prototyping methods and solutions (Rated: most rated it Very High, nevertheless two rated it low (2-3))

Concurrent Engineering Team management methods and issues (Rated: Very High)

The TOPS method (The Ford Motor Company) (Rated: High, some did not know what this meant)

Virtual teaming methods over the Internet (Rated: High)

A 3D Virtual Reality web-based method and code is discussed in detail (Rated: most High, nevertheless two rated it Low (3))

Design For Environment and related Concurrent Engineering and CE Management issues, the way you see them related to the subject area of Hybrid cars (Rated: High)

Design of Experiments (DOE) Application Example, of YOUR choice, with the documentation and the calculations explained (Rated: High)

Industrial and R&D Case studies for every topic (as listed above) (Rated: Very High)

Any other topic you would like to cover? Please explain: (Received 4 requests)

1. JIT (just-in-time) manufacturing: note, that we'll deal with this briefly, nevertheless the IE673 TQM course deals with this in detail;

2. Information management in product/ process integration (we are going to deal with this in detail, see above).

3. The lean manufacturing approach: note, that this is similar to (1) above, nevertheless we'll deal with this briefly.

4. Using simulation tools/ products to determine product effectiveness; we are going to deal with this in detail, nevertheless due to the depth of the simulation opportunities we won't be able to exhaust the topic in this course.

It is over! Congratulations! You can now analyze and improve many products and services!

PLEASE **VIRUS CHECK** EVERY SUBMITTED FILE!

PLEASE save the **TREES**! Please DO NOT Print this syllabus. Use this web site to read it in this electronic format; it will be updated during the semester. Thank you!